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Obituary. WE much regret to learn of the recent death of Mr. Wm. Henry Snell, editor of the London *Electrician*. He died after a long illness on Wednesday, March 5, and in his death electrical journalism has sustained a serious loss. Although still a young man, he had won an enviable reputation both in his chosen profession and in the field of electrical engineering.

A Laboratory for the Brooklyn Institute. FURTHER progress is reported this week from the course of electrical instruction in the Brooklyn Institute. The Institute is specially to be congratulated on the acquisition of an excellent set of electrical measuring apparatus, the gift of a public spirited member. It is seldom that a popular course of instruction starts out more auspiciously. Among the many schools that give electrical training, we must not forget the general good that must result from this establishment of a course for the diffusion of electrical knowledge where it is most available, among the general public and in the midst of a great city.

Urban Electric Traction. AN English report on Wynnes' System for Electric Traction, printed in full in another part of the paper, seems to have provoked a very vigorous discussion on the question of priority. So far as appears at present, Professors Ayrton and Perry have the advantage of being the first in the field, and covering the ground rather broadly. The principle involved is a decidedly interesting one, and it is to be hoped that experiments on a practical scale will soon be made. Electric traction in city streets is now beset with so many difficulties, that there must be a wide spread interest in any scheme which promises a successful way out of them.

The Westinghouse Arc System. WE are at last enabled to present to our readers some details of the new Westinghouse Arc System, of which much has been heard, and very little known, within the past few months. The system has been sufficiently successful in this city to encourage the company that is operating it to increase its plant at once, and it appears that in this method of arc lighting we have a formidable competitor of the present direct current system. Of course it is difficult at present to speak with any certainty of the actual efficiency of the apparatus, or of any possible objections to its use, but it certainly is of great theoretical interest, and has met with no little success in its trials in this city.

An Alternating Motor. WE print in full this week a description of the new Ganz alternating motor, of which occasional reports have reached this country. Until now, however, they have been of a very unsatisfactory character, as the details of the machine were suppressed. The present account is comparatively full, and shows that Ganz & Co. have at least succeeded in completing an alternating motor which, in spite of some drawbacks, has distinctly valuable properties, primarily, that its efficiency is remarkably high, comparing reasonably well with that of direct current motors. While the difficulties connected with starting the motor still remain serious, this latest type of machine certainly promises well for the future efficiency both of alternating current motors and dynamos. The tests of the Ganz 25 h. p. motor, which we have reported in considerable detail, are well worth careful study, and the whole subject is one that will well repay investigation.

Another Mining Machine. WE publish this week the details of a coal mining machine recently devised. The advent of appliances of this sort emphasizes the rapid extension of electricity into this branch of industry. It is to be hoped that much more will be done, for any line of invention that transfers human labor from the foulness and darkness of a mine to the free air above cannot fail of being a benefit to society. The present machine is operated by a Tesla motor and is unusually light, weighing in all but 850 ponnds. This is a step in the right direction, though the great length of the machine must somewhat limit its application. Light and compact mining drills, even if only able to do the work of a very few men, would be of great service in the more contracted portions of a mine. The same principle could be most advantageously applied to rock drills. We have heard more than one inquiry from quarry men for a light electric drill to take the place of the old churn drill, perhaps as primitive a tool as yet remains in common use.

Decision on Storage Batteries. WE publish in full in this issue the important decision of Judge Cox in the infringement suit of the Brush Electric Company vs. the Julien Company. As will be seen from its text, the decision is emphatically in favor of the former company, and the decree of perpetual injunction will doubtless shortly follow. Just how far-reaching the effects of this decision will be it is difficult to say at the present time, owing to the fact that the litigants had arrived at a mutual understanding prior to the decision, and because the suit between the Brush Electric Company and the Electrical Accumulator Company is still pending. This latter suit involves the real questions at issue. As will be remembered, the interference between these two claimants in the Patent Office resulted in favor of the former, inasmuch as the date of the Faure patents in this country was held to limit the question of priority. Still another of the questions left in doubt by this recent decision is that involved in the expiration of an Italian patent to Brush, a question which was not pressed to an issue in the present suit, but may appear in litigation at a later date. It therefore will be seen that, though the decision is an important one, it is not final, although it leaves the victorious party in a position of vantage which may tell on the final result.

Electrical Execution. ON March 21 the Court of Appeals rendered its decision in the Kemmler case. That decision was unanimous and final in upholding the constitutionality of the law which prescribes electric shock as the method of inflicting the extreme penalty exacted by outraged justice. It is unfortunate that the law was ever passed, for it can do nothing but harm to electrical interests; but in view of the facts the decision of the court was to have been expected. We cannot but look with regret on the progress of the case, at every step calling public attention not to the marvelous usefulness of electricity, not to its exquisite adaptability to the needs of industry, but to the possibilities of its misuse, and to its undoubted but preventable dangers. There has not been any reasonable doubt of the power of electricity, deliberately applied for that purpose, to produce certain death, and every effort to show the contrary has only tended to weaken public confidence in those who ought to guide public opinion aright. Nothing more definite can be said on this subject than was said a few weeks since by Prof. Elihu Thomson, himself the inventor of a high-tension alternating system: "All the cases in which persons have received a shock from an alternating current of 1,000 volts or upward without being killed are fortunate accidents, for there cannot be the slightest doubt that such current can and will kill under conditions favorable to its passage through the body." No good can come of underestimating the dangers of electricity—it is infinitely better to admit them, and show what admirable precautions can be taken to secure safety. Nor has there been good ground to doubt that death by electric shock is comparatively painless. It is true no voice can come from those who have thus died to tell us what and how great the final pang may have been, but this much is known, that electricity produces death not by fatal lesions of the vital parts, but by paralysis of the great nerve centres that control life. And from this, and from melancholy facts, it is known that swift death follows instantaneous unconsciousness. And, therefore, we were quite prepared for the decision just rendered. Unless a pardon is granted or the law repealed the original sentence will be carried out. We sincerely hope that sooner or later a law so certain by its operation to exaggerate in the public mind the dangers of electricity will be stricken from the statute books.

Efficiency of Alternating Apparatus. AT the meeting of the Institute of Electrical Engineers, held on Tuesday, March 18, a most interesting paper on the efficiency of alternating apparatus was read by Dr. Louis Duncan, of Johns Hopkins University, Baltimore. At a later date we shall take pleasure in publishing the paper and discussion that followed, as it is a most valuable addition to our somewhat meagre knowledge concerning the efficiency of alternating dynamos. Dr. Duncan's paper was received with the greatest interest and provoked a discussion of no small value, especially since comparisons were drawn between the efficiency of the alternating current system of distribution and that of the direct current system, a subject which cannot be mentioned in any assembly of electrical engineers without exciting extraordinary activity. Dr. Duncan's paper tended to show a rather low efficiency for the alternating system under the usual conditions of supply, but pointed out that under these same conditions no better results could be expected from the direct system. He also suggested the possibility of increasing the average efficiency by the use of large converters supplying so extensive a district that the average load would more nearly approximate to the most economical load. In this connection it may be interesting to note the probable effect of metering electricity. So long as electricity is furnished on the plan of a monthly tariff for each lamp installed, whether used or not, the consumption is likely to be quite liberal and the load of any given converter sufficient to insure a tolerable degree of efficiency; but in a district supplied exclusively by meter it would seem very probable that a natural tendency to economize would lead to the burning of a very small portion of the lamps installed, and consequently the converters would be likely to be underloaded so much as to greatly lessen their efficiency. In addition to this, the same lightening of the load would lessen the efficiency of the generating dynamo. Of course the tariff for light might be made so as to cover this feature of metering electricity; but the subject is one worthy the attention of electric light companies, and it will be most desirable if load diagrams could be obtained from a station which has changed from the method of a fixed charge per lamp to a tariff based on meter indications. We fear that Dr. Duncan's final suggestion, that the direct current system could be very advantageously used for the district immediately surrounding a central station in connection with the alternating system for more distant lights, will not meet with a wide application, but this in no way detracts from the scientific value of his advice.

The New Westinghouse Arc System.

It has been known for a considerable time that the Westinghouse Company has been elaborating a new system of low tension arc lighting, and quite recently it has been advertised extensively, and put into practical use on something rather more than an experimental scale.

We are enabled this week to give our readers some important details concerning the operation of this very interesting system, together with cuts of the apparatus used.

The principle used is rather a departure in the way of arc lighting. A series of transformers is distributed along the line of the primary circuit, and the arc lamps are operated from the secondary coils of these transformers. The series transformer is especially adapted to working an arc system in very much the same way that transformers in parallel are so admirably suited to the needs of incandescent lighting. The conditions of series transformers are very favorable to steadiness of light from the fact that a large change in the resistance of the secondary circuit produces relatively but a small change in the current and electromotive force of the secondary, consequently small variations in the resistance of the arc, and small irregularities of feed, will produce a comparatively slight effect upon the energy supplied to the lamp. This greatly tends to steadiness and regularity of the light. Even if the secondary were short circuited, no serious results would be likely to follow by reason of the properties of the series transformer just referred to. With a dynamo properly self-regulating, and this arrangement of series transformers, the light obtained should be, as it is, steady and efficient. Inasmuch as each arc lamp is operated from the secondary coil of a transformer, the dangerous feature of the arc circuit is in a great measure removed, since unless the primary current should break through into the secondary, an accident which experience has shown is very unlikely to happen, no more than 50 volts electromotive force is at any time in the lamp circuit, consequently an arc lamp operated on this system can (except for the danger of burning one's fingers) be handled as safely as an ordinary incandescent lamp, and as the transformers can be, and are, placed outside the buildings they supply, there is no necessity for a high tension current ever entering the walls of the building.

It should further be noted that not only does the alternating arc system possess these advantages, but it should be a very efficient method of distribution, for, as is well known, the modern transformer is exceedingly efficient when operated at its full load, and inasmuch as these series transformers are so operated, being from the nature of

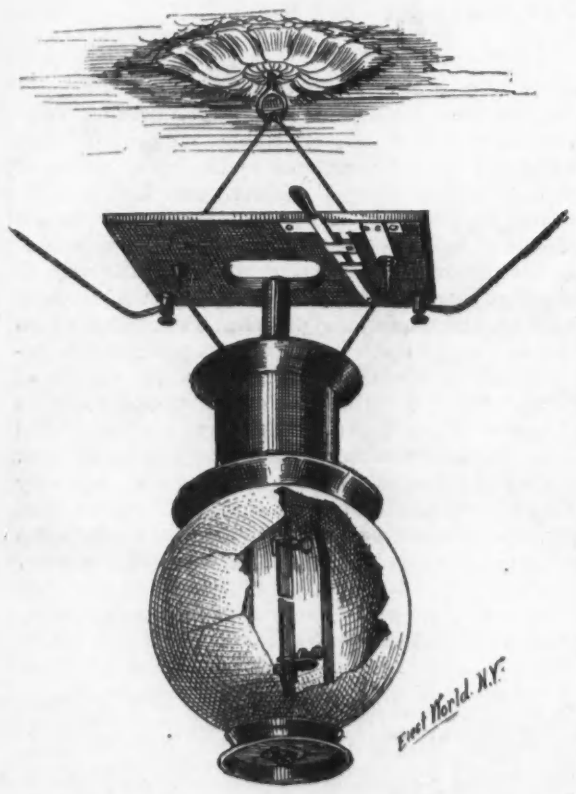


Fig. 2.—Short Arc Lamp for Indoor Use.

things free from the variations in load which can and do injure the efficiency of transformers in a parallel system of distribution, the loss in the transformation should be very small. In fact, it ought not to exceed five or six per cent., although no authoritative figures concerning these arc transformers have as yet been made public.

The dynamo used in this new system of lighting resembles in appearance the ordinary well known Westinghouse incandescent machine, its mechanical features being quite the same. Of its electrical peculiarities we are not able to say much now, as they are not yet made public by the company. We can say, however, that the machine is reported as being extraordinarily well regulated, giving a current very nearly constant through an enormous range of electromotive force.

One machine is at present running in this city, supplying 125 arc lamps scattered along the Bowery. Two other circuits of the same size are soon to be added, as, even in this semi-experimental stage, the lamp seems to be securing a considerable popularity.

The lamps are of 2,000 c. p., using a current of 10 ampères, and having between their terminals a potential difference of about 50 volts. The primary current on the line is a little over 30 ampères, so that the transformer resembles an ordinary induction coil in that it increases the tension and diminishes the current. As will be seen from these figures, the fall of potential on the primary circuit in each transformer is between 16 and 17 volts, consequently the dynamo operates at about 2,000 volts when supplying

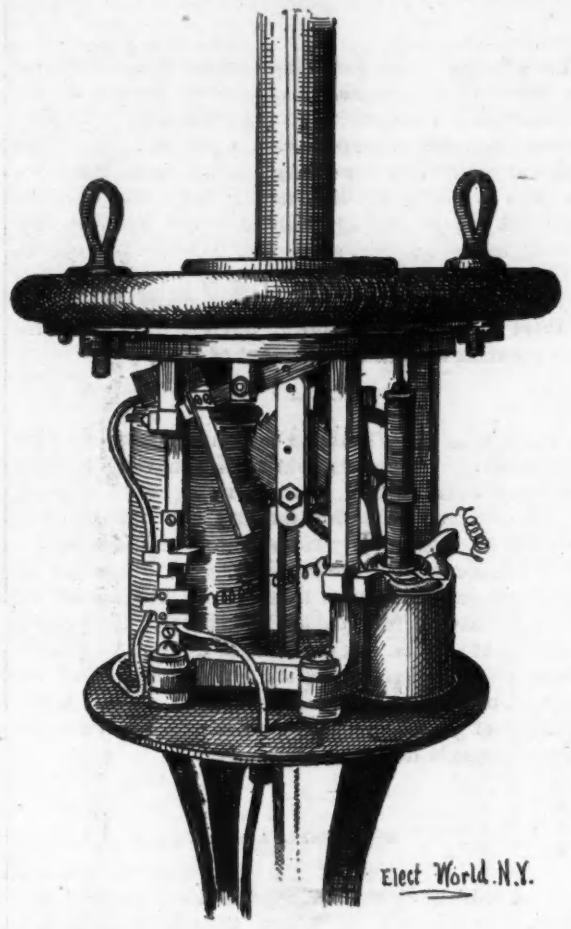


Fig. 1.—Westinghouse Alternating Arc System. Details of Lamp.

the full load. It is obvious that this arrangement makes it possible to supply far more lamps on a single circuit than has been found to be good practice with the ordinary arc system.

The lamp, as will be seen from Fig. 1, which shows its mechanism, is practically the same as the ordinary Westinghouse lamp, having, however, laminated cores in its magnets in order to avoid excessive heating. The mechanism is clearly shown in the cut. It should be noted that almost any arc lamp can be used on this circuit, but a special winding is necessary to secure regular feed.

It has been found best to employ on this circuit a rate of alternation decidedly less than that used for the incandescent system, the actual rate being very nearly one-half that of the incandescent machine. This renders the problem of arranging the feeding mechanism of the lamps much simpler, and reduces the heating to within very reasonable limits.

Both flat and round carbons have been used in these new lamps, the flat carbon being employed to give a long period of burning. They are 2¼ inches wide, usually ⅛ inch thick, and a little over 8 inches in length, two of these carbons being placed in each lamp, instead of one long and one short carbon, as in the ordinary systems. These carbons are reported as giving 44 hours' continuous burning.

Besides the flat carbons, many ordinary round carbons ½ inch in diameter and 8 or 9 inches long are used. These are reported as giving a light of about 13 hours, a period long enough to render double carbon lamps quite unnecessary for all-night lighting.

The indoor lamp illustrated in figure 2 is ordinarily completely encased in a spherical globe of opal glass, and is principally remarkable for its compactness, it being but a little over 2½ feet in length. In the cut the globe is shown broken away so as to display the carbon holders and carbons within. The particular lamp sketched was, as will be seen, trimmed with flat carbons. It should be noted that when trimmed with round carbons, these alternating current lamps give a distribution of light quite different from that obtained with continuous current lamps, for the reason that the alternating currents prevent the formation of the crater, which in many cases interferes with the free distribution of light.

In actual practice the lamps seem to give a clear, brilliant light, quite indistinguishable from that of any other good 2,000 c. p. arc light.

As will be seen above, the consumption of carbons is reported as being much less than with the continuous current lamps. The fact seems to be well attested. The reason for it will be an interesting subject for investigation.

In Fig. 3 is seen the transformer used in this system. There is nothing remarkable about its appearance, and its construction differs from that of the ordinary Westinghouse transformer principally in being arranged to increase the voltage and diminish the current, instead of the reverse. Special pains have been taken, however, in the insulation of the converters. A series of tests made for the United States Illuminating Company, which operates the system in this city, showed that the insulation from primary coil to box of the converter averaged between 30,000 and 40,000 megohms, and the insulation from secondary to box was nearly as great. These tests were made to insure compliance with the underwriters' rules for insulation, and consequently the insulation from primary to secondary was not given, but the result reported was sufficient to indicate that it should be extremely good.

The system is theoretically most interesting, and its operation in practice seems to be such as gives great promise for its future as a method of arc lighting. Later we shall hope to give more details of the system, especially concerning the dynamo, in which is employed a new method of regulation, the regulating devices being entirely confined to the armature. The results of this method are said to be remarkably satisfactory, and its details will certainly be of great interest.

More Electrical Apparatus for the Transvaal.

We gave a description some time ago of a large installation for the electric transmission of power which was being manufactured by the Sprague Electric Railway and Motor Company for the Forbes Reef Gold Mining Company of the Transvaal, South Africa.

This plant will transmit power from a waterfall, where are situated a number of Pelton wheels, to the mine premises, more than three miles away. The wires connecting the water wheel with the electric motors at the mine will be carried upon poles right across country in a direct line. The amount of power transmitted will be 140 h. p.

The Forbes Reef Company are now so thoroughly satisfied that electricity is the most convenient and economical agent for transmitting power long distances, and applying it at its point of use, that the managers of that company have ordered additional apparatus, including dynamos and motors, with wires, for the transmission of 75 more horse-power. This will make a total of 215 h. p. to be transmitted from the water power, which will be used on the mine premises.

The efficiency of the whole electric system will be about 70 per cent.; that is, out of every ten units of power delivered

Fig. 3.—Westinghouse Transformer for Arc Lighting.

from the turbine to the dynamo, seven units will be delivered from the motor pulleys for work, and only three lost in the transmission and in both machines.

When the long distance which the power is transmitted is taken into consideration, this is a remarkable record.

Part of this apparatus has already been shipped to the Transvaal, and the rest will follow soon. The construction and installation of this plant will be under the direction and supervision of Mr. Wm. Rydler, of the Sprague Electric Railway and Motor Company.

When this is finished it will be one of the largest electric mining transmission plants in the world. While it is to be regretted that the managers of mines in this country have as yet not availed themselves to any very great extent of the advantages in the transmission of power by electricity, it will probably not be long before many of the water powers which now run to waste in many mining localities will be utilized with advantage.

Another Good Word for Electric Traction.

One of our Western contemporaries says that President Thomas Lowry, of the Minneapolis Street Railway Company, is a firm convert to electricity as a motive power for street cars. When he asked the City Council a few months ago to try electricity on the Fourth avenue line he was an unbeliever. Four months of rapid transit on this line, without an accident or a break, have transformed him into an electrical enthusiast and his patrons into happy beings. The electric car in Minneapolis is a great success.

The Fourth avenue car line is three miles long, running to Thirty-fourth street. It formerly required forty-eight minutes to make the trip one way with two horses. It was walk up grade, jerk and pull on the part of the horses, and it was a constant trial of patience for the passengers. It is different now—on the Fourth avenue line. The person who boards the car at the post-office building at First Avenue South is set down at Thirty-fourth street in twenty-two minutes by present schedule time, a gain of twenty-four minutes, and he has not experienced a jar, either in starting or stopping, but has been carried along swiftly, up grade and down grade. He likes the electric cars. He enjoys the ride because he is usually able to get a seat, as two cars are run together instead of one, and at no additional expense to the company except for one conductor. The two cars run every seven minutes on this line; the time used to be every ten minutes for only one car. The improved service is due solely to the electric system. When horses pulled the cars 112 were in service, and only 83 out of the 130 cars run over the line every day went beyond Twenty-fourth street. Now 225 cars are run over the line every day, and all of these run to Thirty-fourth street. To manage this number of cars under the old system would require 300 horses. In running 112 cars with horses the company employed 12 drivers and 12 conductors. In running 325 electric cars a day the company now employs 10 drivers and 18 conductors, an increase of only four men.

The electric car has thus been demonstrated to be a complete success in Minneapolis. Without regard to the temperature during the winter, the loads of people were carried along with the regular speed, and a snow blockade was unknown. It is an easy thing for a snow-storm to block up a horse-car road, but it must be an exceedingly lively storm that can conquer an electric car. The snow-plow that the horses lug along on the car lines works altogether too slowly to keep pace with a driving storm. On the electric line each car carries a snow-plow, so that every seven minutes the road is cleared. They are aided by the big brush car that is run over the line, sweeping the loose snow off the track and leaving the bed as hard as a floor. A snow blockade thus becomes a rare thing on an electric road.

A New Central Station.

We illustrate herewith the fine central station of the Municipal Electric Light Company in the Eastern District of Brooklyn. It is situated on the corner of Ainslie and Rodney streets, and is a large brick two-story building, 75x80 ft. The walls are 2 feet thick, and strengthened with buttresses 2 x 3 feet every 10 feet around the building.

As in many of the more recent central stations, the dynamos are on the floor above the engine room, the first floor of this building being devoted exclusively to the engine and boiler rooms and coal vaults. On the second floor is the great dynamo room, the testing room and the superintendent's office. The boiler room runs parallel with Rodney street, and in it are placed the battery of seven horizontal tubular boilers, six feet in diameter and 16 feet long. They are made of $\frac{7}{16}$-inch steel, with heads $\frac{9}{16}$-inch. At the back of the boilers is a well-lighted passage extending the whole length of the battery, giving free access to the blow-off and the flues. The coal vaults have a capacity of 250 tons, and are fitted with an endless chain conveyor driven by a small engine to take the coal from the sidewalk and dump it into the vaults at intervals of five feet, thus leaving very little trimming of coal to be done. For feeding the boilers there are two Niagara steam pumps, which can also be used in case of fire. Stand-pipes and hose are also placed in different parts of the building. The chimneys are 125 feet high, sectional area, 25 feet.

The illustration on this page gives a good idea of the building itself, and of the dynamo room and switch board, The dynamo room is exceptionally well lighted within.

The motive power is furnished by two tandem compound condensing engines, built by Wm. Wright of Newburgh, N. Y. The frames are specially heavy, being designed for electric light work. The high and low pressure cylinders are respectively 24 and 42 inches in diameter, and each a 36 inch stroke. At 90 revolutions per minute, with steam pressure at 125 lbs., each engine develops about 600 horse power. The details of the engine are well shown in our second illustration, which also shows one of the condenser pumps and the battery of boilers. The condensers are of the independent type, with air and water cylinders, which are both driven from the same engine. Two large Worthington pumps supply the condensers.

Water for condensing purposes is obtained from ten driven wells 4½ inches in diameter and about 30 feet in depth. The engine shafts are 14 inches in diameter at the journals, with a swell to 16 inches at the centre. The fly wheels are 18 feet in diameter and 48 inches face, and are belted direct to separate lines of shafting supported, as shown in the cut, on a series of iron columns near the ceiling of the dynamo room. The pulleys driving this shaft are 6 feet in diameter and 48 inch face, and are perforated to prevent air cushioning. Driving pulleys for the dynamos are so arranged that with the eight rows of dynamos in the room, any one of them can be easily seen from any part of the room.

On entering the dynamo room one is naturally surprised at the seeming absence of wires and conductors. These are all carefully carried through the floor across to the switch board which is located in the centre of the room, and forms a part of the partition between the dynamo and testing rooms. The switchboard, which is decidedly ornamental, is a departure from the average form of arc light switch board. It is 22 feet in length, and eight feet six inches high. The front is of black walnut, neatly paneled and handsomely finished, four rows of connections being arranged horizontally, the two lower rows being terminals for the leads from the dynamos, and the two upper the terminals of the various circuits. The circuit is completed by using a flexible cord with suitable plug attachments to fit into the connectors in the board. These plugs are held firmly by springs, placed on the inside of the board. It will be seen that the switchboard is very conveniently arrranged, and the impression conveyed by the arrangement of the dynamo room is one of neatness and efficiency. It is refreshing to see a dynamo room so well lighted and so arranged

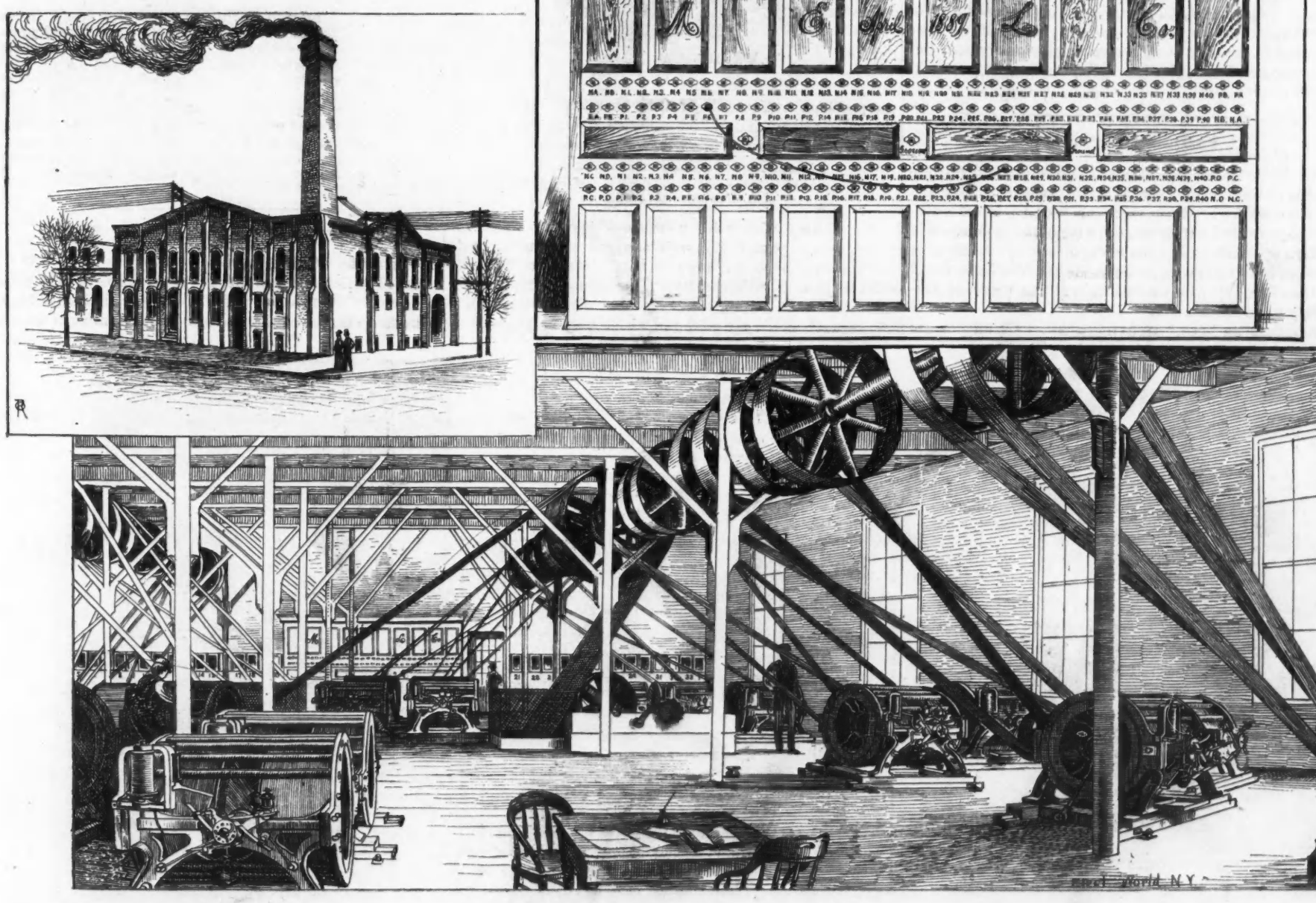


FIG. 1.—MUNICIPAL ELECTRIC LIGHT COMPANY'S STATION BROOKLYN. INTERIOR OF DYNAMO ROOM, AND SWITCHBOARD.

that every machine can be carefully watched during its performance. It is to be hoped that the days of putting dynamos in the back end of a boiler room are forever past, and each central station like the one illustrated marks a step in advance in the art. It is hard to estimate the advantages which follow from the use of a conveniently-arranged dynamo room, kept as only a separate dynamo room can be kept.

The switchboard, too, is remarkably neat and well arranged, giving great facility in handling and shifting the various circuits in the complicated way that is so often necessary in the operation of a great central station.

This fine plant is operated by the Municipal Electric Light Company, of which Mr. W. H. Blauveldt is manager and Mr. J. Ferguson is superintendent.

Electric Lighting of Railway Trains.

Continuous progress is being made in the methods and devices employed for train lighting, and just now the thing most eagerly sought by those interested is a high-speed engine for direct coupling. With large dynamos the problem is not so difficult, but with the small machines used for train lighting, such high rotative speed is demanded that it is a very severe strain on the engine.

There is a good field for an engine that will run 900 to 1,000 revolutions per minute, and inventors should tackle the problem. The late John Ericsson devised a high-speed engine which ran at 1,200 per minute very successfully for some time, but of late nothing has been heard of it. The difficulties in the way of such speed are considerable, but a very fast running engine is wanted and probably it will soon be forthcoming,

Puzzling Paragraphs.

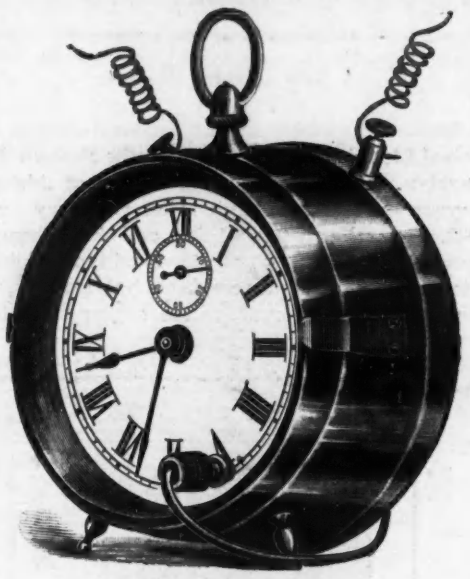
A nice little mathematical puzzle is that contained in the billheads of the Edison Electric Light Company. One and one-fifth cent per light per night is charged, but if a consumer pays his bill within ten days from date a discount of one-sixth off is allowed. "A very nice way for them to figure out is an even cent an hour," said a Wabasha street man the other day who was taking off the discount preparatory to paying his bill.

"One cent an hour," said his clerk. "Well you are away off. One and one-fifth less one-sixth used to leave one and one-thirtieth when I went to school, and I guess it does yet"

"But that is not the proposition," replied the proprietor, who then undertook to prove that one and a fifth less a sixth equals just an even integer. A number of bystanders became interested in the problem, and in a moment numerous pencils were flying, while each one was endeavoring to be the first to arrive at a correct result that could be proven.

"Well," said the proprietor, as he looked over his spectables, bystanders very much amused at the furore he had started, "I never had much schooling myself, and perhaps it does require a course in college to solve a little thing like this. But I want to tell you that I can prove my assertion without making a figure. You cannot deny that one and one-fifth cents are equal to 12 mills, can you?" "No." "Well, now, just take one-sixth off, or 2 mills, and you have just 10 mills, or 1 cent, don't you?"

"One cent," he continued as the gaping group of high school students began to comprehend the true meaning of the problem. "You fellows better exercise a little in mental calculations and do less figuring, especially on a simple proposition like this one."—*St. Louis Dispatch.*



A Diabolical Device.

A Diabolical Device.

We illustrate herewith a peace-destroying invention which seems remarkably well adapted to remove one's last lingering hope of a morning nap. Its nature is quite evident from the illustration. It consists simply of a small, innocent-looking clock provided with suitable electric contacts and a movable pin which may be inserted in the face and turned to any hour desired. To set the alarm for any hour it is only necessary to insert the contact pin in its place and turn the bezel that holds the glass to the required point. When the hour hand of the clock touches the pin it starts an electric gong which may be placed close to the sufferer's bedside and continues to ring unremittingly until the contact pin is removed from the clock face. One hundred feet of wire is customarily supplied with this clock, so that to remove the obdurate pin will require a sufficiently long journey to remove the last possibility of further slumber.

This electric alarm clock is manufactured by the Manhattan Electric Supply Company of this city. As a passing suggestion, it might be well to operate it with some good constant battery so that there would be no possibility of the bell ceasing to ring by reason of the batter y running down

The Speed of Dynamos.

BY J. M. KENT.

One day, while listening to the hum of the brushes upon the commutator of a dynamo, it occurred to me that this sound furnishes a ready means of approximately determining the revolving speed of the machine.

Take any musical instrument which has been tuned into correct concert pitch, and find, by experiment, the half tone which nearest corresponds with the hum of the brushes.

Then, if we know the number of vibrations per second required to produce that tone, we have only to divide that number by the number of segments in the commutator and we have the number of revolutions made by the machine in one second. The following is approximately the vibrations per second of the notes of the scale starting with middle C: C = 264, C-sharp = 275, D = 297, D-sharp = 310, E = 330, F = 352, F-sharp = 367, G = 396, G-sharp = 412, A = 440, A-sharp = 458, B = 495, ^{2}C = 528, etc.

For example: If we found that the hum of the brushes corresponded with G-sharp, and we know that there are 40 segments in the commutator then, we have the speed of dynamo $= \frac{412}{40} \times 60 = 618$ revolutions per minute.

[Our correspondent's method of estimating speed is certainly ingenious, and for any one with a good musical ear it would be a very convenient one. Most people, however, would not find it easy, we fear. A tuning fork or pitch pipe would furnish ready means of comparison. We have ourselves found this method of noting the pitch of the sound produced very handy for hunting out the induction of various disturbing circuits on a telephone line. Where electric cars are operating, for instance, it is very easy to distinguish the various effects of the generating dynamo, the motors and a neighboring electric light line.—Ed. The Electrical World.]

Mechanism of the Shallenberger Meter.

To the Editor of The Electrical World:

Sir: Please inform me through the columns of your paper the cause of the rotation of the disc in the Shallenberger alternating current meter, and also why it always goes in one direction while the current goes first in one and then in the other direction. F. W. Updegraff.

[Answer.—The discs on the Shallenberger meter are actuated by an armature, the rotation of which is caused by the establishment of an alternating line of polarization, by the current traversing the coil and a second line of polarization having an angular displacement with regard to the first, obtained by a second coil placed in inductive relation to the first, which form two corresponding lines of different phases in the armature, the mutual attractions of which act upon one another. The rotation is continuous, because the lines of polarization alternate in polarity with each alternation of the current, and thus always exert a similar relative attraction. The reversal of the direction of rotation is effected by swinging the moveable coil through a right angle.—Ed. E. W.]

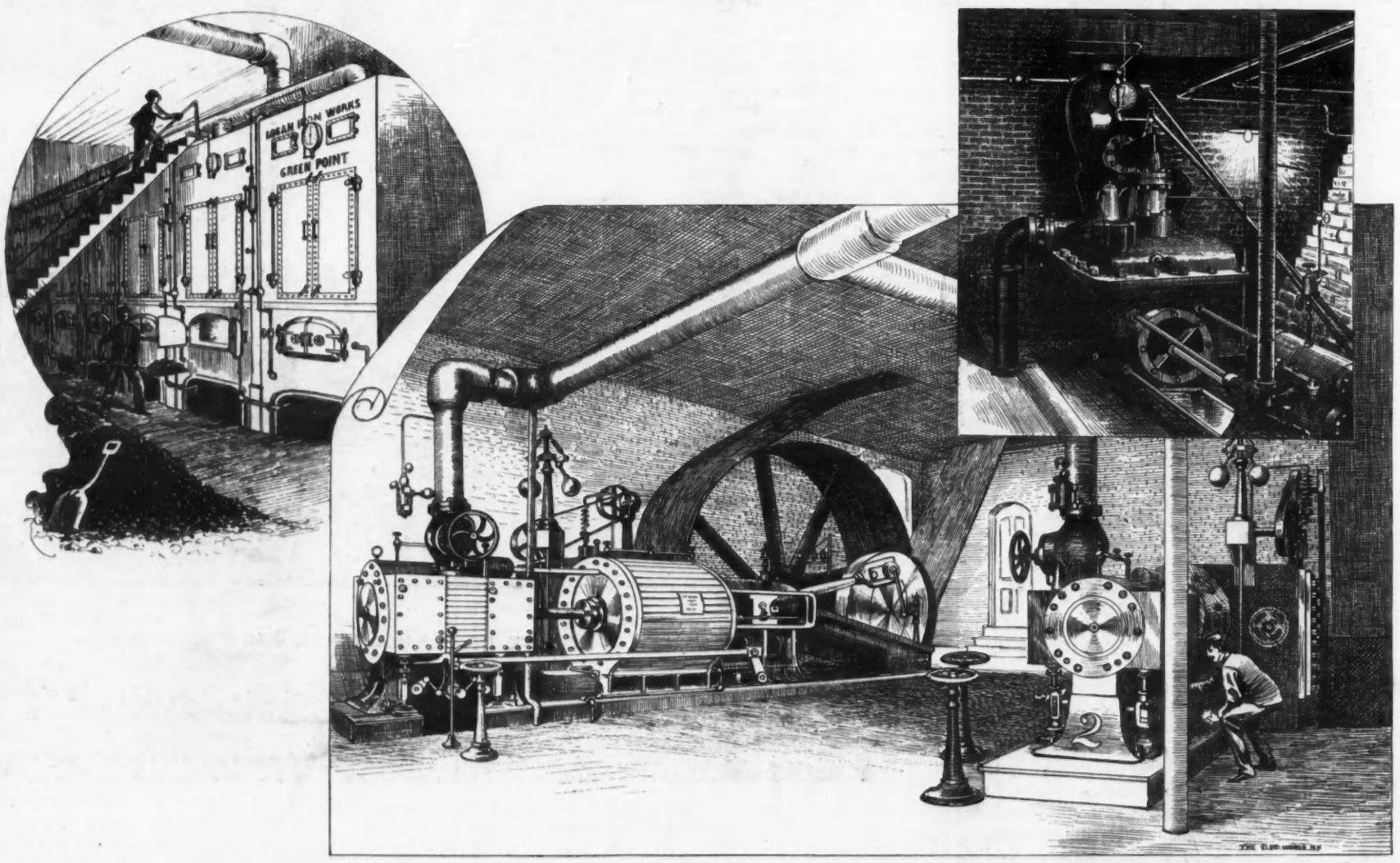
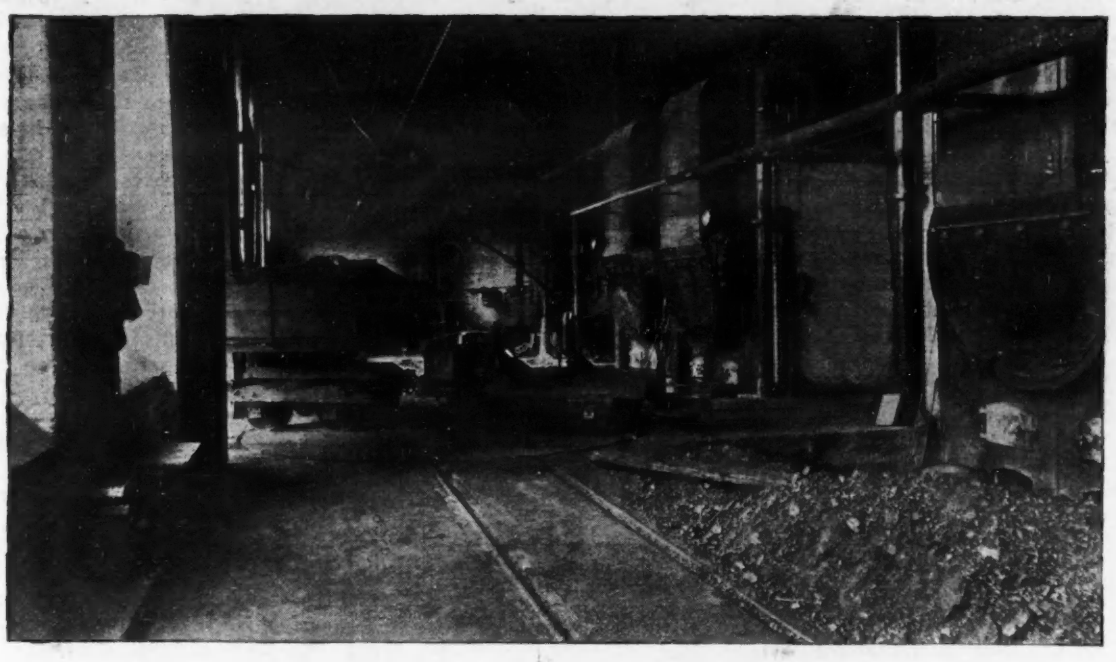


FIG. 2.—MUNICIPAL ELECTRIC LIGHT COMPANY'S STATION, BROOKLYN. BOILER ROOM AND ENGINE ROOM.

Mill Tramway at Lawrence, Mass.

Conclusive proof of the fact that electricity can be used to advantage for mill tramways is shown in the accompanying illustrations, made directly from photographs of the installation at the Washington Mills, Lawrence, Mass., which has recently been completed by the Thomson-Houston Motor Company. The tramway is used exclusively for carrying coal from the coal pockets to the boiler room, a distance of about 400 feet. The track is level the entire length, and for the most part straight, there being but two curves: an S curve just after leaving the coal



WASHINGTON MILLS TRAMWAY. COAL BINS.

pockets, and a similar one, though a less sharp turn, where the track enters the boiler house.

In the electrical construction the overhead system has been used, brackets being employed to support the trolley wire, which runs in height from 12 feet, where all is clear, to 6 feet, where the track passes underneath a belt box between two of the mill buildings, the springs on the trolley arm being so adjusted as to maintain an even pressure of the trolley against the conductor, irrespective of its height. The current for the operation of the motor car is supplied from a 110-volt dynamo, which is used for mill lighting; the rails and a supplementary ground wire being used for the return circuit.

The car equipment consists of one ordinary dump coal car and one platform car provided with one three horse power 110-volt series-wound motor geared to the car axle, and capable of developing sufficient power to haul a load of 5,000 pounds at the rate of six miles an hour. At one end of the car are placed two levers, one for the special type rheostat used for governing the motor, the other for the reversing switch. Both of these, as well as the brake handle, are under the immediate control of the operator, who stands upon the platform in front. The floor of the car is made so that it can be readily removed to allow an easy inspection of the motor and appliances, which, though covered with a thick coating of coal dust at all times, have not failed to operate satisfactorily since the tramway was first put in operation.

Large Sale of Railway Apparatus.

The recent sale of the Essex Passenger Railway Company, the Irvington & Newark and the Newark & Elizabeth railways to a syndicate of Philadelphia capitalists has resulted in a consolidation of these systems into one company.

The syndicate have secured a franchise for the use of overhead wires, and have concluded a contract with the Thomson-Houston Electric Company to equip their roads.

The magnitude of the sale will be better understood when it is known that these combined roads have 85 miles of track, have 280 cars and over 1,600 horses, and carried last year over 18,000,000 passengers.

In all the streets of 60 feet in width or over the poles will be placed in the centre of the streets between the tracks. In streets of less width the ordinary system of overhead wiring will be used.

The total cost of making the change will amount to over $2,000,000, the electrical apparatus alone amounting to over $1,400,000.

It is proposed to begin the work of introducing the electric cars as soon as the necessary legal formalities are complied with in the consolidation of the companies. The first lines to be equipped will be those having the greatest amount of travel, so as to give quick transit and increased facilities to the greatest number of the patrons of the road.

The Rapid Transit Company, of Newark, are also rapidly building their road, and have also contracted with the Thomson-Houston Company for the use of their system, and they will use about twenty 30 h. p. double motor trucks to begin with and will subsequently increase if their business warrants.

Mr. T. C. Barr represented the Philadelphia syndicate in the negotiation for the purchase of electrical apparatus, and Mr. R. H. Sherwood, of the New York office, represented the Thomson-Houston Company.

The Zipernowsky-Deri-Blathy Synchronous Motor.*

A synchronous motor is set in motion by an alternating current sent through the armature, and when working under normal conditions the number of revolutions is equal to the number of alternations. An alternator, the magnets of which are excited by a direct current, can be used without difficulty as a synchronous motor; but the alternator must be brought to synchronism before it will work. The magnets of a synchronous alternating motor can be excited by an alternating current; for this purpose a revolving commutator is necessary to give the requisite direction to the current impulses in the magnets. In its simplest form such a commutator consists of as many segments as the motor armature contains coils, the even segments being connected to one another and to one end of the magnet coils, whilst the odd segments are also connected to each other and to the opposite end of the magnet coils. If the brushes are given the proper position it is evident that (supposing the motion to be synchronous) each time the current changes its direction the connections to the magnets will be reversed, so that the magnets are excited by a uni-directional intermittent current A diagram of the essential parts of such a motor is shown in Fig. 1.

In a motor with fixed magnets and rotating armature two additional pairs of sliding contacts are required to supply the armature with current and to take the current off the commutator to the magnets. Motors arranged as above can also be started by an alternating current, but the iron of the field-magnets must be protected against Foucault currents. When in such a motor a favorable position is given to the armature and the magnets (or a slight motion imparted), an alternating current will start it, and the speed will increase until it is running synchronously; but practically such a machine is useless on account of sparking, both during the first motion and at full speed.

It is this difficulty which Zipernowsky, Deri, and Blathy claim to have overcome. The sparks are caused by the extra currents induced at each alternation. The current is only strong enough during part of the period to keep the magnets sufficiently magnetized, and when the strength falls off an extra current is induced in the magnet coils.

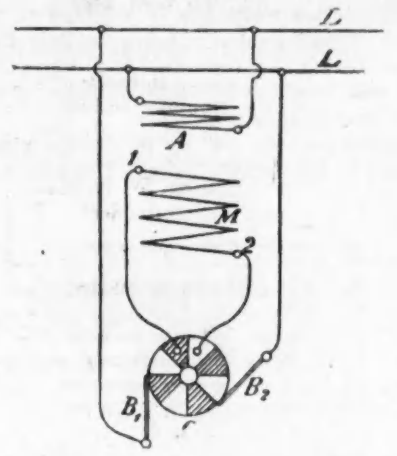


FIG. 1.

At this moment a path of low resistance is provided and then immediately broken again. Sparks are the result. The intensity of the fields also undergoing great fluctuations, speed of the motor is very uncertain, and it easily falls out of synchronism. All this is overcome by short-circuiting the magnet coils a short time before the reversal of the current, the brushes being so arranged that at the moment of segment-change the extra current acts in opposition to the main current, getting rid of the sparks. The momentary short-circuiting is effected by employing four brushes, which are connected as shown in Fig. 2; 1 and 2 being connected with one lead, and 3 and 4 with the other, the magnet coils being short-circuited during the time that the brush 2 is on the shaded segment. The distance between the contact points of the brushes 1 and 2 is $\frac{1}{4}$ to $\frac{1}{4}$ of the width of a commutator sector. It is, of course, not necessary that the brushes at one end of the conductor should

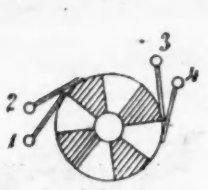


FIG. 2.

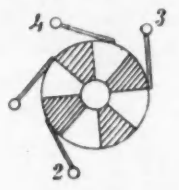


FIG. 3.

be on the same segment, as they may be on different segments of the same class, as shown in Fig. 3, the effect being the same; or, instead of two separate brushes, one with a broader bearing surface may be used. Numerous tests show that with this arrangement of short-circuiting the brushes, sparking at the commutator is obviated, and the motor runs synchronously.

The above arrangement is perfectly satisfactory when the motor has attained the synchronous speed; but starting is difficult, and the torsional moment being small, the normal speed is not quickly reached. At starting, a slight displacement of the brushes is necessary. An arrangement has therefore been adopted by which one brush of each pair, 1 and 3 or 2 and 4, may be cut-out at starting, or both of each pair 1 and 2 and 3 and 4 are brought to the same respective segments, so that no short-circuit occurs. As soon as synchronism has been reached, the arrangement permits the other two brushes to be brought to the positions shown.

The short-circuiting of the magnet coils may also be effected by the use of two commutators side by side, the segments of which overlap each other (as shown in Fig. 4),

WASHINGTON MILLS TRAMWAY. BOILER ROOM.

*From *The Electrician*, March 7.

to the extent required to bring about the requisite short-circuiting. The necessary removal of the short-circuiting at the start can be brought about either by taking away the short-circuit brushes or by the automatic arrangement shown in Fig. 5.

To prevent too great an increase in current during the short-circuiting, a resistance is provided in the circuit. The same object is gained by using an induction coil, the windings of which are connected to the armature and the magnet coils respectively. The induction prevents a too great increase in current (Fig. 6).

This motor has been put up in various places, among which may be mentioned—Wiener Neustadt, three motors

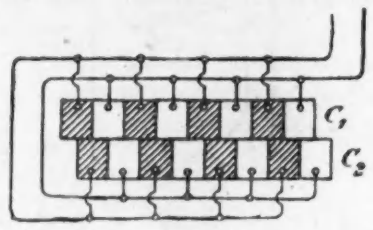


Fig. 4.

of 10 h. p., and Innsbruck, one motor of 50 h. p., one motor of 10 h. p., and one motor of 5 h. p.

The following abstract of the report of the committee recently appointed by the town council of Frankfort-on-Main to inquire into the alternating and direct systems of distribution will be of interest in this connection.

On the question of the output and efficiency of the Ganz alternate current motor, the committee report that experiments were made with the 25 h. p. and 5 h. p. types. The former gave efficiencies of 82 per cent. to 88 per cent. for outputs of 15 to 35 h. p., the 5 h. p. showed efficiencies of 60 per cent. to 80 per cent. for outputs of 3 to 8 h. p., the figure for normal load being on an average 78 per cent. The efficiency, therefore, does not differ to any important ex tent from that of direct current motors.

With respect to starting, it was found that the 25 h. p. motor could not start itself, and the smaller sizes, 5 h. p.

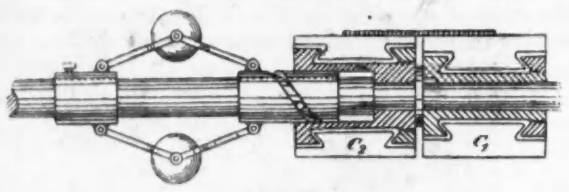


Fig. 5.

and 1-5 h. p., were unable to do so in certain positions. A test as to starting the motor with full load on was not made, as Messrs. Gauz & Co. objected to it. The time necessary for the attainment of normal speed was from 30 to 45 seconds. The start was always accompanied by heavy sparking at the brushes, diminishing as the normal speed was reached. In the 25 h. p. machine these sparks were 5 cm. long, and 3 cm. on the 5 h. p. machine. At normal speed the sparking was not worse than with direct current motors.

With regard to noise, the committee pointed out that from the nature of the action, as well as from the sparking, when not running synchronously more noise was to be expected from the alternating current machine. In factories and on tramcars this noise was unimportant; but it would exclude the larger sizes of the motor from dwelling houses, unless exceptionally good foundations were secured. With

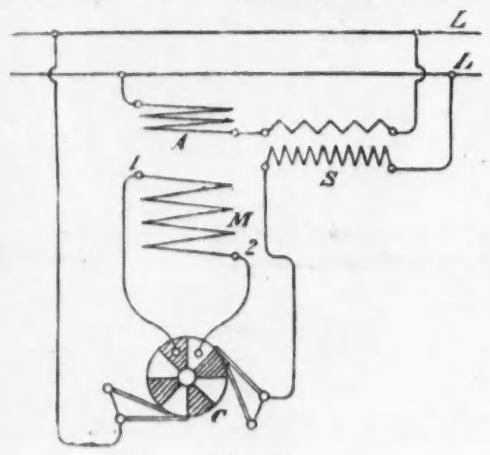


Fig. 6.

the small motors the noise would not exceed that of the machines used to drive sewing machines with. The motors being synchronous, regulation of speed could only be arrived at by means of multiple-speeded pulleys.

A series of tests was made to ascertain the effects of sudden application of load and of overloading, and it was found that the 25 h. p. motor did not fall out of synchronism till it was loaded with 40 h. p., and the 5 h. p. motor could be loaded up to 8 h. p., in each case a maximum load 60 per cent. in excess of the normal. A sudden load of 26 h. p. can be put on to the large machine when running light, though a heavier load than this suddenly applied will cause it to stop. When running at 26 h. p. a further sudden load of 8 h. p., and after the application of this a further 6 h. p., can be put on, the total load being then 40 h. p. The whole of this load can be suddenly removed without affecting the behavior of the machines. The 5 h. p. machine could take a sudden load of 6 h. p., which in the same way could be suddenly increased to 8,

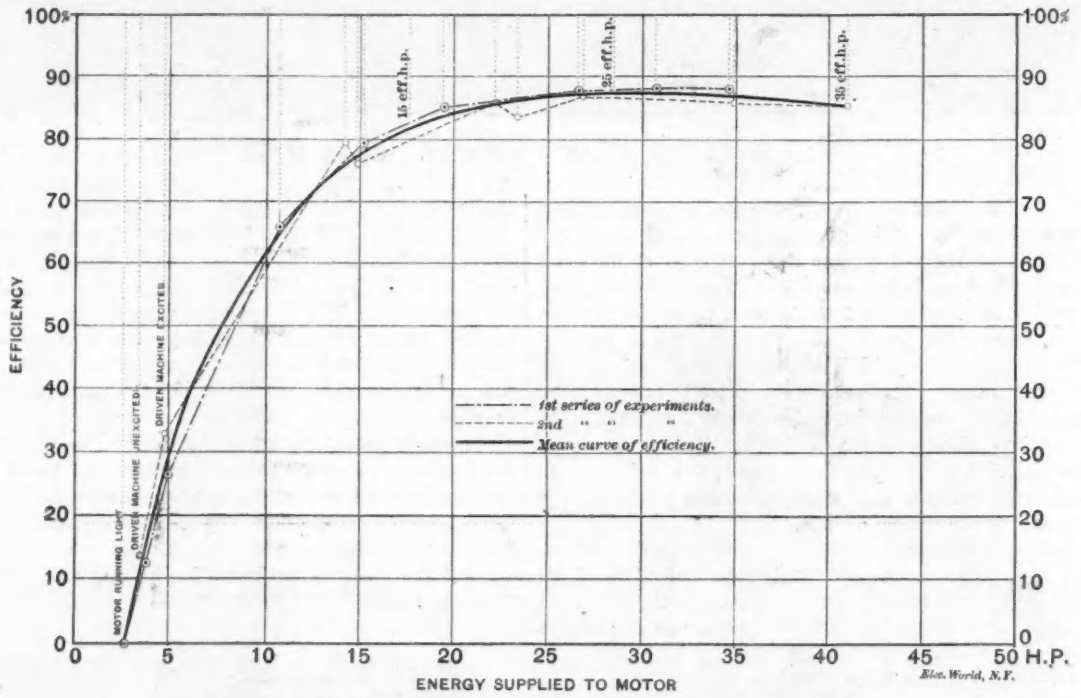
These tests show that the normal output must be kept well under the possible maximum, or, in other words, that a considerable margin must be allowed in settling on the size of machine to be employed. It should be mentioned that the machines tested were the second of their respective classes that had ever been made.

We are fortunately able to add to the preceding details concerning the Ganz alternating motor some interesting details of its performance as tested at Frankfort, and the diagram showing its efficiency at various loads.

The principal test was made on a 25 h. p. Ganz motor, and the results were, to say the least, very remarkable. The motor, as is evident from the preceding description, belonged to that type of motors derived from the separately excited alternating dynamo, and such motors, while synchronizing perfectly with the alternations of the supplied current, are all open to the objections that they will not start automatically, and if overloaded they will stop. They are also subject to destructive sparking, and the improvements in the motor under consideration are largely in the line of overcoming this latter difficulty. All motors of this type are subject to losses which may be considerable from Foucault currents in the iron of field magnets, and in general have the merits and demerits of an alternating current dynamo of the type mentioned.

The Ganz motor, like some alternating current dynamos, was excited by a commuted alternating current, but in this particular case the current was derived from the main circuit through the medium of a converter which reduced the potential to 25 volts.

In the tests the current was supplied from a 10-pole alternating dynamo by Ganz & Co., giving 50,000 watts



EFFICIENCY CURVE OF GANZ ALTERNATING MOTOR.

at 2,000 volts. This machine was driven by a 50 h. p. engine, which also drove the direct current exciter. The speed of the alternating dynamo was about 500 per minute, giving during most of the experiments 4,940 reversals per minute. The tests were apparently conducted with the greatest care, and among the delegates for the firms interested were men as well known as Deri, of Ganz & Co., and Dubois Raymond, from the firm of Siemens & Halske. The method of testing employed was to employ the motor to drive a continuous current dynamo feeding incandescent lamps to measure the currents supplied to the motor and supplied by the driven dynamo, and then to estimate the losses in this latter machine. The driven dynamo was one of the continuous current type Ganz & Co., and it supplied two hundred 32 c. p. incandescent lamps, each taking 100 watts, at 100 volts. These lamps were arranged into independent banks of 10 so that the load could be readily varied. The energy supplied to the motor was measured by a watt meter previously compared with the Cardew volt meter and the Standard air meter, and the current supplied from the driven machine could be readily measured. Its efficiency was known, and in addition to this the losses in it could be computed quite closely.

The efficiency tests extended over an entire day and were made throughout a wide range, the output varying from 41 h. p. to friction of the motor. Under these varying and often unfavorable conditions the performance of the motor was most extraordinary. The results obtained in a single typical series of experiments were as follows:

Watts' Motor.	Dynamo output.	Dynamo losses.	Motor output.	Efficiency. per cent.
22,700	18,400	1,600	20,000	88.1
25,500	20,660	1,760	22,420	87.9
19,500	15,580	1,430	17,010	87.3
14,330	10,930	1,210	12,140	85.2
11,200	7,730	1,120	8,850	79.0
7,900	4,200	1,020	5,220	66.0

These figures give an idea of the remarkable results obtained. These, with a number of others, are used to determine the efficiency curve of the machine reproduced herewith. On inspection it appears that the efficiency is remarkably high through a wide range of load. It only falls below 80 per cent. when the machine is run at half load, and perhaps again when the load is doubled. Between these load limits the efficiency varies only about 8 per cent.

The motor was also given a most severe test of its regulation. It was loaded with the lamps up to an output of 26 h. p. The whole load was then thrown on and off, with the admirable result that the speed varied from the normal rate of 540 per minute by less than one per cent.

The actual rates observed were :

Load, 26 h. p.	Speed, 540
Load thrown on	" 545
Came back to	" 540
Load thrown on	" 536
Came back to	" 540

It is unfortunate that we do not know more details of the mechanism of a machine which performs so excellently. The regulation is all that could be desired, and the efficiency the highest, so far as we are aware, ever obtained from an alternator, dynamo or motor. The method seems fair, the power supplied being measured by a carefully calibrated wattmeter in the primary circuit of supply, and the electrical output of the driven machine being measured by voltmeter and ammeter, and finally referred to the same instruments which had been used to calibrate the wattmeter. The losses in the driven machine do not seem to have been overestimated. It would have been desirable to have interchanged the wattmeter with the voltmeter and ammeter in part of the experiments, but the substantial accuracy of the result given by the driven machine is attested by the load in lamps. Making all allowances, we are driven to the conclusion that we have here a performance that augurs well for the future efficiency of alternating apparatus.

It is unfortunate that a motor so remarkable for efficiency should not start with more readiness than the tests show. The design of the motor must have been extraordinarily good, or such efficiency could never have been obtained, and it is clear that if means could be provided for starting it with its full load it could compete successfully with any of the ordinary types of continuous current motors. It is this difficulty of starting, more than any other, which has stood in the way of the success of the alternating motor thus far. Most alternating motors, to be sure, have not shown any such high efficiency as the one herein described, but these tests show clearly enough that the efficiency can be secured, and that the only serious obstacle is the single question of starting.

The means adopted in this Ganz motor for obviating excessive sparking seem to have been more than usually successful. The sparking at the start was formidable, but in less than a minute the motor had gotten up speed and the sparking was then not worse than ordinary direct current motors. It is certainly a hopeful sign that so practical a form of alternating motor has been devised, and it certainly gives promise that the difficulties inherent in successfully operating alternating motors may be finally overcome. It must be remembered, however, that a rectified alternating current is not at all an equivalent for a continuous current, and that for a motor to be thoroughly successful, it must be able to start with its full load. It is to be hoped that at a later date the details of construction of this Ganz motor will be made public, together with its weight, efficiency and other mechanical properties.

At a later date a full report of the Frankfort commission will be published, containing interesting details of the tests of small sizes of these motors.

The Michales Electric Mining Machine.

The advent of electricity in the mining regions is kindly received, with a positive assurance of its great value. It seems to hold forth a promise toward the solution of many problems in the way of transmission of power that have heretofore baffled us.

The arguments in favor of its use in mines are volumin-

ous, and its introduction for underground work of various descriptions is destined to be a most important branch of electricity, especially in combination with lighting. The accompanying cuts show the construction of a very simple and ingenious machine, designed to adapt and utilize the electric current for the laborious portion of miners' work.

The following is a brief description of the machine. Fig. 1 is a side view with one-half of the machine proper removed. Fig. 2 is a top plan view with motor removed. Fig. 3 is a detailed view showing revolving cam *F*, thumb *b*, and crosshead *U V* of the drill bar. Fig. 4 is a rear end elevation. As will be noticed from the engravings, the machine is mounted on a two-wheeled truck. It is 9 feet in length, 1½ in breadth, 2½ in height, and weighs about 850 pounds. It is supported with sliding axles *X X* for the purpose of balancing when a shorter or longer pick *R* is used. It is mounted with a 2 h. p. Tesla motor *A*, from which the power is transmitted through a combination of gear wheels *B C E* and shafting *D* to a cam *F*, rounding the drill bar *I*. Within this cam *F*, on the drill bar *I*, is placed a thumb *b*, on the end of which is a small trolley wheel *a*, to prevent friction as the cam *F* passes in front of it. By the rotation of this cam *F*, its inclined surface *F*, Fig. 3, passes in front of this trolley wheel *a*, Fig. 3, forcing it back and up the incline *F*, Fig. 3, drawing with it the drill-bar *I*, against the tension of a powerful spring *K*, which encircles it, until the vertical wall of the cam *F* passes beyond the trolley wheel *a*, Fig. 3, when it is automatically released and forced violently forward by the action of the spring *K*, the trolley wheel *a*, Fig. 3, returning to the bottom of the incline *F*. In order to alleviate the shock to which the machine would be subjected in case the pick *R* should not strike against the coal, there is an extremely powerful spring *N* interposed between the shoulder *M* on the drill bar *I* and the front end of the tube *L* which surrounds it. The springs *K* and *N*, constructed especially for this machine, are of different tension and mathematically correct, and can be changed in a moment as the character of the work requires. The machine strikes 120 blows per minute and with a force of 9,000 pounds to the blow.

To convey the current from the dynamo at the entrance of the mine to the motor on the machine, well insulated wires are strung along the side of the entries near the roof, being suitably fastened to the props or plugs placed in the coal for this purposes. Switches are placed opposite the entrance to each room in order to facilitate the changing of the machines from room to room. Wires are coupled to the main circuit in the entry to convey the current to the machine.

The Tesla motor, manufactured by the Westinghouse Electric Company, has been adopted for operating the machine. This motor is peculiarly fitted for mine service owing to its compactness in design and simplicity of construction. The unique and especially valuable feature is that the current in the armature is an induced current. The ends of the armature wires are soldered together, and there is no electrical connection between the armature and the outside circuits. There are no brushes to require adjustment, or to spark or burn out a commutator. The absence of commutator and brushes allows the armature, which is the only moving part of the motor, to be completely inclosed and protected from mechanical injury. No regulator of any kind is used, and the only piece of apparatus in connection with the motor is a simple switch.

Owing to the continuity of the circuit and the absence of brushes and bare contacts requiring adjustment or handling, it is perfectly feasible to use an electromotive force higher than could otherwise be conveniently handled. The motor has been operated with a pressure of 250 to 300 volts. It can easily be constructed for use with either a higher or lower pressure, according to the requirements in special cases. The extreme simplicity of the electrical part of this mining machine enables it to be put into the hands of miners who have had no previous experience with electrical machinery.

Lights can be taken off the circuit at any point, and, if so desired, the mine can be lit up almost as light as day. When a room or mine is finished, it will require but little time or expense for the wires to be taken down and removed to another.

One very commendable and unique feature of this machine is that at whatever point in the stroke the pick is arrested, it is instantly returned from that point ready for the next below; and when the blow is delivered, even though it be arrested in its course, instead of the machine pushing itself away from the coal, as one would naturally suppose it would do, it rather inclines to the coal owing to the momentum of the drill bar. It will not interfere with the working of the machine where it is necessary to post close to the face of the coal.

The machine is light and easy to handle; being composed principally of steel, is very strong and durable, and will stand almost any amount of abuse. It is very simple, beautiful in design, and neatly finished. The method of operating this machine is as follows: The machine having been placed to the coal, the operator takes his seat behind it, and having perfect control of it, places each blow, as would the hand miner, where it will be most effective, cutting from four to six feet deep. This cut is made on a level with the floor, being of a V shape, eight inches in front and tapering back to two inches in the rear, making an average cut of five inches. When the under cut is made, the operator in like manner can shear the ends. One great advantage of this V shaped cut is that, when the coal falls it will roll over and out of its original position, where it can be very advantageously loaded. It requires one man and helper to operate the machine.

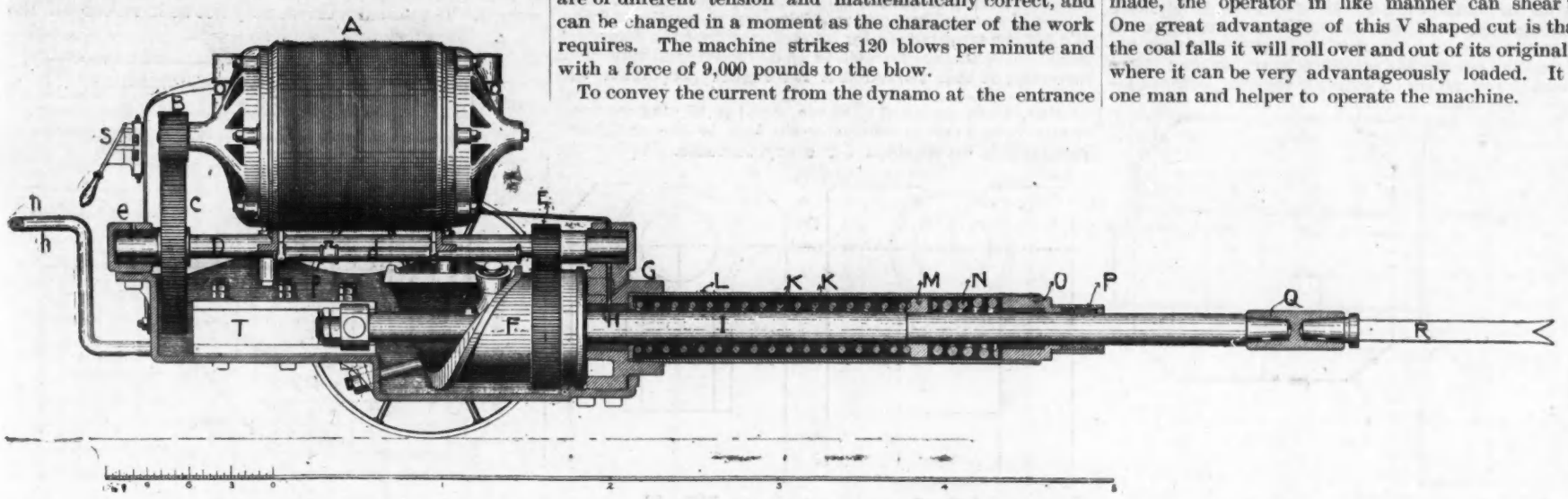


FIG. 1.—MICHALES MINING MACHINE—SIDE VIEW.

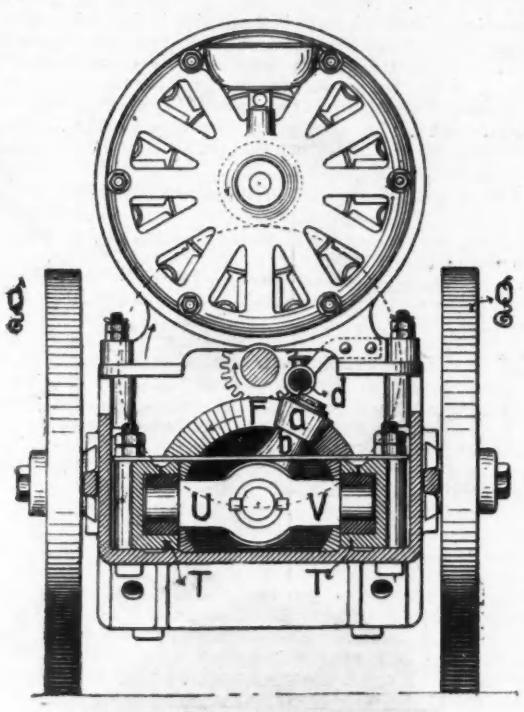


FIG. 3.—DETAILS OF MECHANISM.

The experienced operators in mining machines say that it is the easiest machine to handle they ever held, being almost entirely free from recoil.

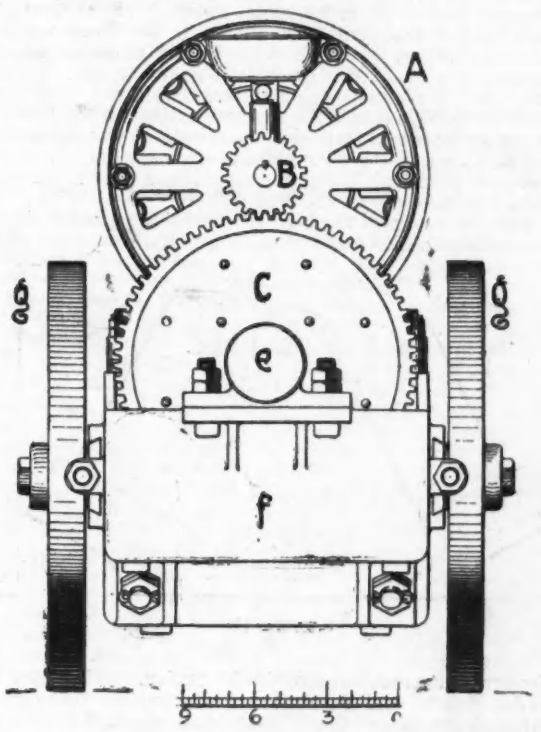


FIG. 4.—REAR END ELEVATION.

The machine has been thoroughly tested in the hardest coal in Western Pennsylvania, and the results have been of a most gratifying nature. Besides the practical miners who have sat behind the machine, there have been many operators from this and other States to see the machine in

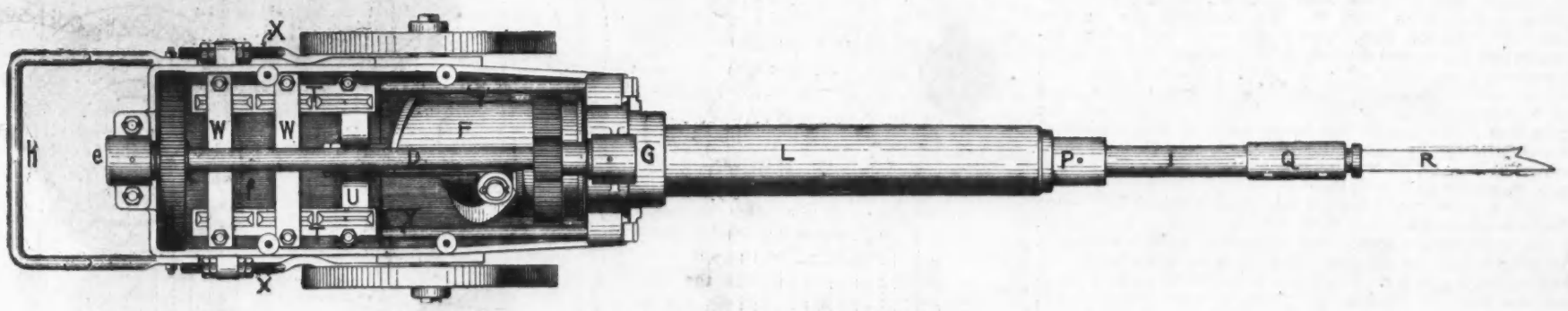


FIG. 2.—TOP VIEW—MOTOR REMOVED.

A Characteristic Letter from Mr. Edison.

In answer to a letter sent to Mr. Thomas A. Edison by Mr. Catlin, manager of the National Fast Telegraphing Tournament, referring to the rapid rise to fame and prosperity of the former, and the possibility of his having drifted too far away from telegraphic associations to be interested in the coming tournament, the following characteristic reply was received:

CHARLOTTE, N. C.

FRIEND CATLIN: I hope I haven't changed a particle. I'd rather have the small-pox than a swelled head. Put me down for twenty-five. Yours, THOS. A. EDISON.

All communications should be addressed to the Michales Electric Mining Machine Company, Pittsburgh, Pa.

Some Points in Dynamo and Motor Design.*

(*Continued from page* 214.)

Electrically there is in drum armatures no want of balance due to an unsymmetrical field, as every convolution of the conductor encloses the whole of the lines of force passing through the armature core. The only result of a want of symmetry is that the position of the brushes on the commutator for a sparkless collection may become more marked, and the variation of current possible without re-

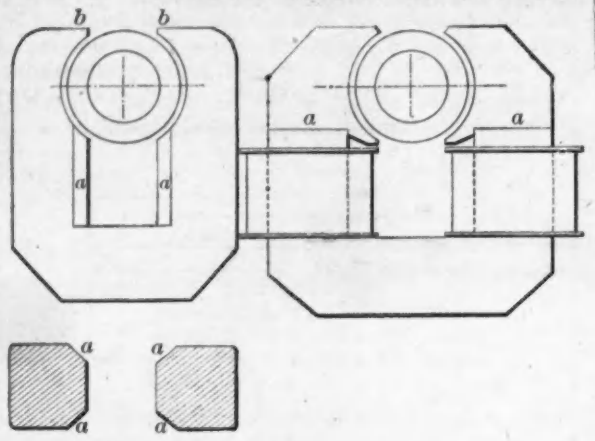


FIG. 7. FIG. 8.

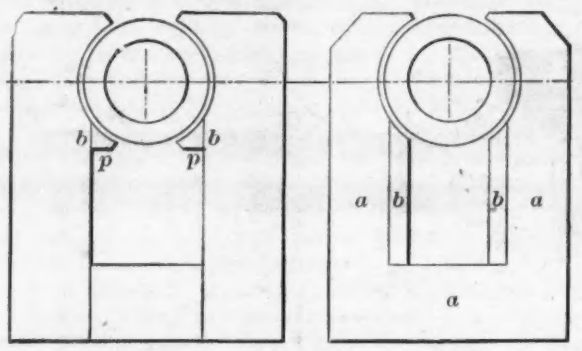


FIG. 9. FIG. 10.

adjustment of the brushes therefore less. But in cylinder-wound armatures not only is there a want of magnetic balance when the field is unsymmetrical, but from the fact that each convolution encloses only half the lines passing through the core, there is a want of *electrical* balance, and it becomes, in consequence, doubly important to get a symmetrical induction, or the same number of lines through each half of the armature. Though the lines were unequally divided, there might not be any appreciable difference in the E. M. Fs. generated in each half with the brushes diametrically opposite; but from the fact that a want of electrical balance requires rather more lead to be given to the brush farther from the yoke, it is possible that the E. M. Fs. in the two halves of the windings may be unequal, the result being a local current round the armature, and consequent waste of power.

There are several methods of obtaining an approximately symmetrical field besides that already mentioned of placing

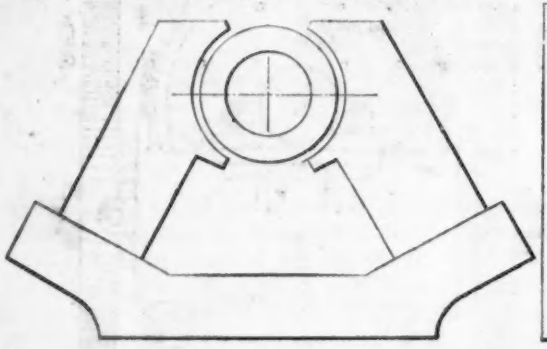


FIG. 11.

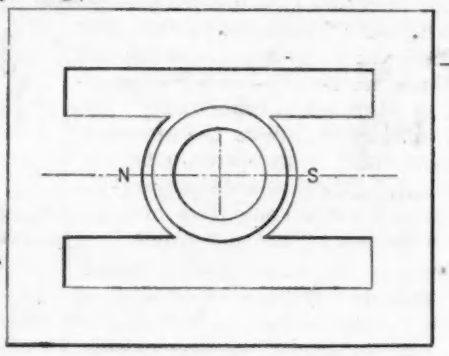


FIG. 12.

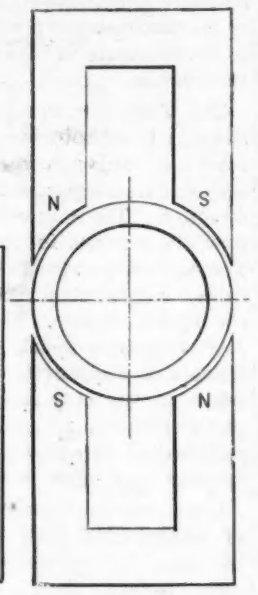


FIG. 13.

the armature eccentrically in the cavity. What we have to do, if possible, is to make the path for the induction through the half of the cylinder core which is farther from the yoke, of similar resistance to the path through the nearer half, so that a similar number of lines may flow through each. In the Phœnix dynamo we employ sometimes, with this object in view, the device shown in Fig. 7. Here the cast iron magnet, instead of being rectangular in section, has the inside corners cut away, as shown in the section at *a*, the top corners at *b* being left on. In this way the magnetic resistance across the bottom path is increased, and the induction in the two halves of the armature made equal. Another plan is to shape the magnets as in Fig. 8, there being a faced joint at *a*. A plan adopted in several direct-driven ship sets we have just completed is shown in Fig. 9. The magnets are in this case of wrought iron, the limbs and top polar expansions being in one single forging, while the bottom polar expansions, *p*, are of cast iron. The magnetic resistance of the cast iron, combined with that of the joint at *b*, compensates for the diminished length of the induction path through the lower half of the armature. Another design by which the same end may be attained is shown in Fig. 10, where the magnet is partly of wrought iron, *a*, and of cast iron, *b*.

With a view to obtaining a more symmetrical field, some single-magnet machines have been shaped as in Fig. 11. Here, to attain the object, the magnetic circuit requires to be lengthened, the magnetizing force required being correspondingly greater. In Fig. 12 is sketched a single magnet machine in which the field is quite symmetrical, although here the magnetic circuit has been made still longer.

It will be understood that it is possible to have an armature out of balance magnetically while electrically it is perfectly balanced, as, for example, a drum armature in the mis-shapen field, Fig. 4. On the other hand, it is possible to have magnetic balance while electrically there is want of balance, as may be the case when a cylinder armature is placed in the four-pole field, Fig. 13.

When the armature core is carried round by spider arms, which fit into slots in the iron washers, it is important that the reduction of the core area due to these slots be as small as possible. Variation in the section causes magnetic kicks, or periodic fluctuations in the field during rotation.

4. RATIO OF ARMATURE SECTION TO FIELD-MAGNET SECTION

In the early days of dynamo-designing, the cross section of the armature core in cylinder machines was very small in proportion to that of the field magnets, the copper in the armature was excessive, and the air gap correspondingly great. The result was an induction no greater than in modern machines, but an enormous stray field. In the machines made by my firm six years ago, the section of the armature core was about one-third of the section of the magnets, the latter being of wrought iron. I may say these machines anticipated Mr. Swinburne's latest notions, inasmuch as the 14-in. armatures of those days were loaded to 25,000 ampere turns. The first great improvement consisted in doubling the iron and halving the copper, a machine so modified giving about the same output, but with less heating and less sparking, and requiring less magnetizing force. We got the same output for two reasons; first, the decreased magnetic resistance resulted in an increased total induction; secondly, of this induction a far higher proportion was utilized. The ratio of the armature section to the magnet section, when modified as above, stood at .66 ; but we went much beyond this in increasing the iron in the armature, finding that we obtained for every increase, keeping the air gap the same, an increase in the induction. The latter was not, of course, in proportion, but it was still very considerable, as will be realized from the fact that in an armature having a ratio of .75 the induction was 10 per cent. greater than in one having .6. When Mr. Kapp read his Paper here on "Characteristics," * I mentioned that then the ratio in our dynamos stood at .75. Since then we have, in machines for incandescent lighting, returned to .6, for a reason which will be by-and-by apparent. It may be mentioned here that when the magnets are of cast iron the ratio is .33, while the cast-iron yokes for wrought-iron magnets are from two to two and a-half times the area of the wrought iron.

I bring this forward because it is of some importance when the aim is to construct dynamos having a large output for their weight. The weight of the armatures is only a fraction of the total weight of the machine. The field magnets are many times heavier, but, besides these, the bed-plates, bearings, etc., make up a large portion of the weight; and since the weight of neither magnet nor bed-plate is increased by an increased armature section, manifestly, if a large output for the weight is the object, and if nothing occurred to interfere with the process, the cross-section ought to be increased to such dimensions that for any further increase to the total weight of the machine we get no corresponding advantage.

Some interesting experiments to determine this point, which completely corroborate my own, were made by Mr. Dugald Jackson, of Cornell University, and communicated by him in 1887 to the American Institute of Electrical Engineers.† These experiments can be consulted by those interested; for the present my remarks are based on the results obtained. Assume that the iron core of a cylinder armature having a ratio of .6 is one-tenth of the weight of the machine; then, by increasing the ratio to .75—that is, roughly, increasing the weight by 25 per cent.—we make an increase in the total weight of 2.5 per cent. But the increase in the induction will be about 10 per cent., so that clearly an advantage has been gained by increasing the section. If we increase the mass of the armature core by 50 per cent., it makes 5 per cent. increase in the total weight, but we get 15 per cent. increase in the induction. If we go further we shall still get an increase, but it gets correspondingly less with each addition to the weight. The actual increase may not be in all cases in the

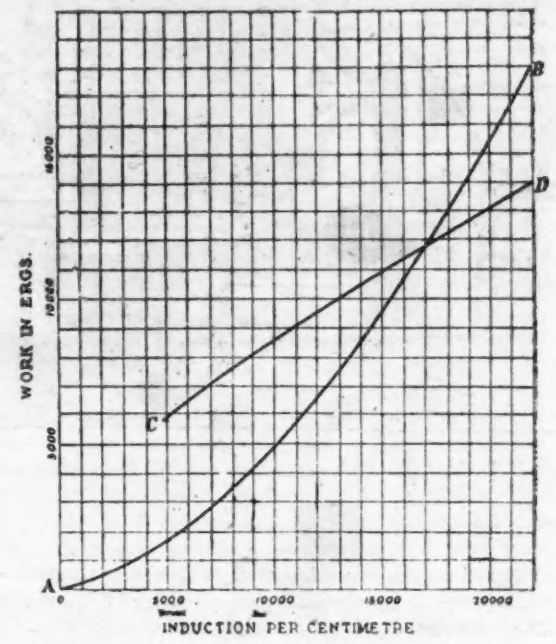


FIG. 14.

proportion I have given. Necessarily it depends upon the design of the machine, but in the particular dynamo to which my remarks refer the results were as stated; and what I wish to point out is that in the light-weight dynamos the armature must have a comparatively large section, and be worked at a lower saturation. Though the output for the armature weight is less, the output for the total weight is greater.

There is a limit to increasing the cross section of the

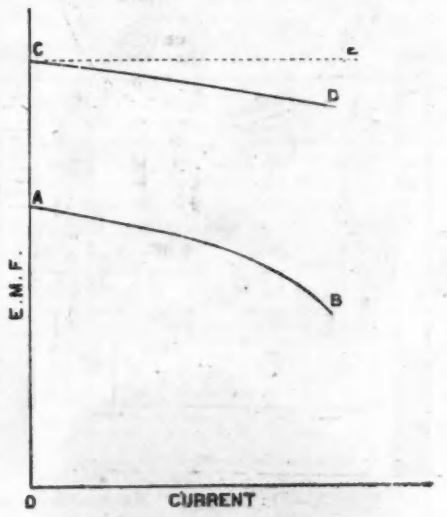


FIG. 15.

armature, which is reached when self-induction troubles us by creating a tendency to sparking, and cross induction troubles us from the diminished saturation of the core.

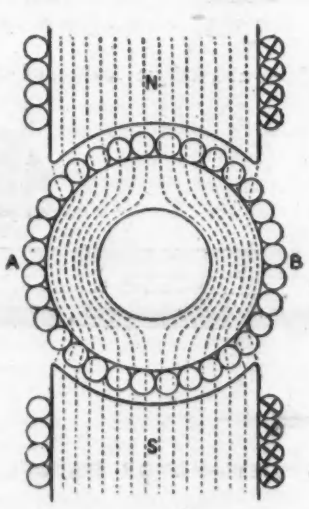


FIG. .16.

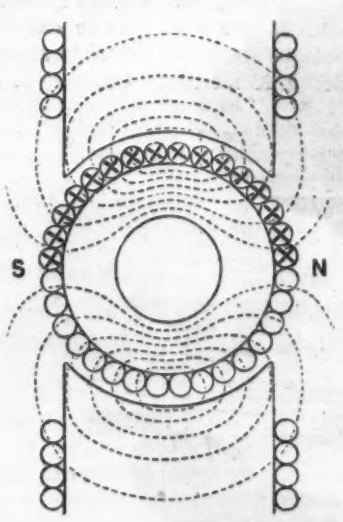


FIG. 17.

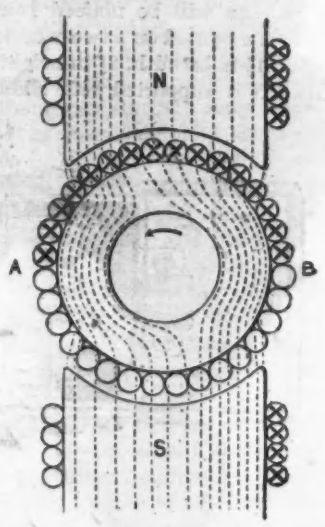


FIG. 18.

Accordingly the practical limit in this direction is fixed for us at about .75, and the induction at 14,500 or 15,000 C G. S. per square centimetre. It must not be forgotten that increasing the section of the core increases the length of the wire on it by a small percentage.

Pressing the induction up to high values is not advisable, as the magnetism then costs too much. It will be seen from the curve (Fig. 1) that the magnetizing force to produce an induction of 18,000 per square centimetre is about twice, while the magnetizing force for 20,000 is more than six times that required for 17,000. As the core saturation is increased the stray field is increased, while the heating due to hysteresis is also greater. Everything considered, 17,000 per square centimetre is probably the best degree of saturation to employ for cylinder armatures, and makers who once employed a greater induction are, I believe, coming down to this. If we work lower we get on the bend of the curve, or on that part where the angle changes rapidly; so that it is not possible to obtain in compound machines with a lower induction such perfect regulation.

* A paper read by W. B. Esson, Member, before the Institution of Electrical Engineers, London, Eng., Feb. 20, 1890.

* Nov. 11, 1886. See *Journal* Soc. Tel. Eng., Vol. XV., p. 548.

† The Electrical World, May 28, 1887.

It may be mentioned in passing that, since the loss of potential in the armature and series winding is generally in slow-speed machines a higher proportion of the E. M. F., in these the difference in the induction on open circuit and at full load is proportionally greater, and the compounding, in consequence, less perfect.

There is no particular advantage in reducing the induction, save that of obtaining a higher weight efficiency. The reduction of the loss due to hysteresis is very small, and less than might at first sight be imagined. In Fig. 14 is given a curve, *A B*, showing the energy in ergs required to carry a cubic centimetre of iron through a complete cycle of magnetization at different degrees of saturation. Induction per square centimetre is measured by abscissæ, and the energy by ordinates. It will be observed that for 17,000 the energy is greater by about 24 per cent. than for 15,000; but for an armature of given output the cross-section of the core has to be increased in proportion as the induction is diminished, and the total work expended in carrying the armature through a cycle of magnetization is, roughly, proportional to the ordinates of the curve *C D*. To draw this curve an induction of 17,000 is taken as the normal, and all the ordinates of *A B* multiplied by the ratio of 17,000 to the induction. It will be observed that for any specified output there is only about 8 per cent. more power wasted in hysteresis at an induction of 17,000 than at 15,000.

In four-pole machines it is usual to saturate the armature to a lower degree—about 14,000; and in alternators the induction is still less—about 6,000. As the curve *A B* gives energy in ergs, the watts expended in the armature are found by multiplying this by the number of cycles per second and by the number of cubic centimetres in the armature, and dividing the product by 10^7. In drum machines the induction per square centimetre is rather over half of the value given for cylinders, and the ratio of armature to field section varies from .8 to 1.0. The diameter of the armature being fixed with reference to the number and size of conductors, there is nothing to be gained by cutting away the interior of the washers. On the contrary, by cutting an opening only large enough for the shaft, the induction is kept low, and the magnetizing force for the armature correspondingly small, while the heat generated due to hysteresis is also diminished.

5. INTERFERENCE OF THE ARMATURE FIELD.

Though iron may vary in quality, and so upset occasionally our calculations, no great difficulty need be experienced in approximating pretty closely the magnetizing force required for a given induction in the armature core. But when we allow a current to flow in the coils, and so magnetize the core, we superpose on the original a second field and the interference between them renders the case no longer simple. If we excite the field magnets of a dynamo with a constant current, and allow currents of various magnitudes to flow through the armature, we find on maintaining the speed uniform that the E. M. F. falls as the current is increased. In 1884* some investigations of mine were published which dealt with this question, and established the result that when the ampère-turns on the armature were few, and the field strong, the fall of E. M. F. with a fixed load was about proportional to the current. As the field was weakened the line representing the E. M. F. began to bend, until, when it was very weak, a kind of inverse characteristic was obtained, as shown in Fig. 15. In fact, the results are similar to those which would be obtained by reducing the winding on the magnets; the effect due to this being small when the magnets are fairly saturated, and large when they are far from saturation. It was then observed that the Hefner von Alteneck winding produced least weakening effect on the field, while the now defunct Bürgin produced most, the Gramme taking a position between these two. Since that date electricians have talked frequently of the weakening effect on the magnets of the current flowing in the armature; but though it is admitted that the induction is the resultant of the magnetizing forces both on magnets and armature, the conditions determining this resultant are by no means clearly comprehended.

Consider the magnetic system shown in Fig. 16. *N* and *S* are the North and South poles of a field magnet, the magnetizing currents flowing into and out of the paper as shown by the open and crossed circles respectively. There is no current flowing in the armature coils, and the lines of force flow from pole to pole through the core as indicated by the dotted lines. Imagine that the current flowing round the magnet is stopped, and that a couple of brushes placed on the collector at *S N* (Fig. 17) cause a current to flow through the armature winding alone. We have the lines along paths indicated by the dotted lines, and obviously through this circuit at right angles to the other the cross induction depends, for a given number of ampère-turns, mainly upon the length and cross-section of the air gap. If we place the brushes at right angles to this position, we have no cross induction, but, instead, an induction taking the same path as the forward induction, though in an opposite direction. If the current is allowed to flow through field and armature coils at the same time, as it does in actual machines, we have the distribution of field

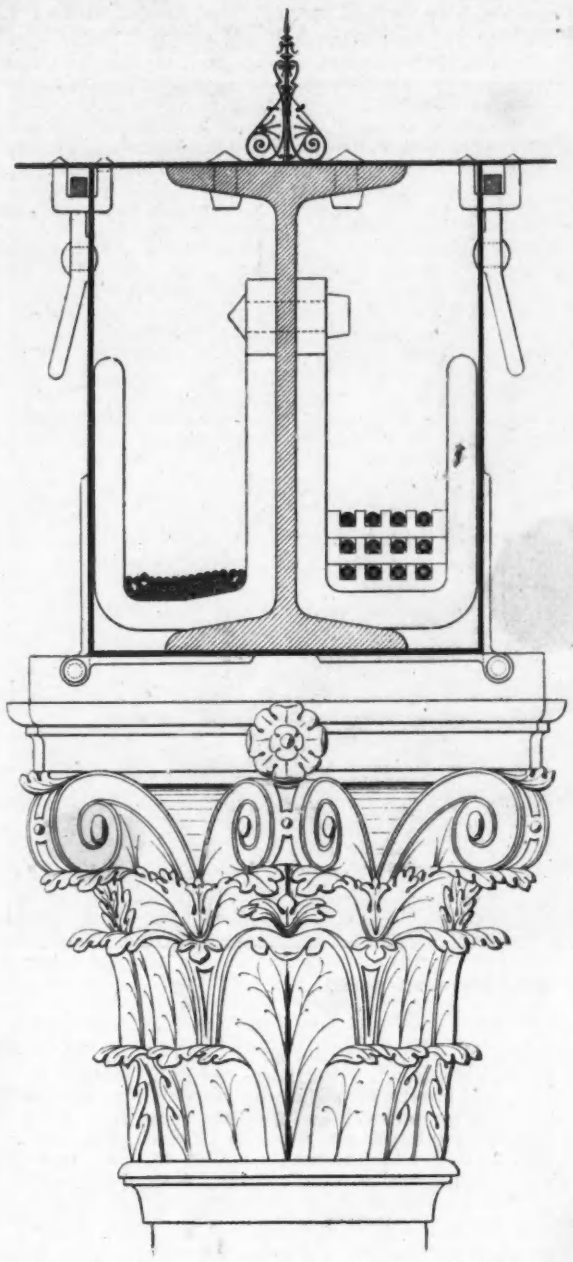


FIG. 1.—OVERHEAD CONDUIT SYSTEM—SECTION.

as sketched in Fig. 18, the lines of force due to the magnets being pushed toward the left-hand top corner and right-hand bottom corner of the poles. Where the armature or cross induction opposes the magnet or forward induction, the field in the air gap is weakened; where the cross induction helps the forward induction, the field is strengthened. In consequence of this distortion with reference to the brushes, the sections under them have become active, and to avoid sparking a lead must be given, which will remove the commutated sections beyond the sphere of activity. This lead diminishes the forward induction, at the same time diminishing the distortion with reference to the new position of the brushes.

6. THE EFFECT OF DISTORTION ON THE E. M. F.

The distortion of the field produces in a dynamo run without lead a diminution in the E. M. F., for two reasons—first, because the induction acts differentially on the conductors lying between the brushes; secondly, because the currents flowing in sections active when short-circuited under the brushes weaken the field. These local currents induce lines in the opposite direction to the forward induction.

Let the machine run as a motor in the opposite direction, the currents flowing through the field magnets and armature being of course in the same direction. The E. M. F. is induced in the armature in the opposite direction, and since in an active coil short-circuited under the brushes the current will flow in the direction of the induced E. M. F., its effect will be to directly strengthen the field as it increases the forward induction. We may say, then, that the effect of distortion is to diminish the E. M. F. in a dynamo run without lead, and increase it in a motor, owing to the local currents generated in the short-circuited coils.

The difference in the E. M. F. of a machine run without lead as dynamo and motor may be considerable, as shown by Prof. Ayrton's experiments at the beginning of last year. These experiments were made on a drum machine which had a comparatively weak field. I am not quite certain as to whether the cause here given is sufficient to account for the difference, but I believe that were the brushes adjusted in each case until the local currents were annihilated, the same E. M. F. would be, with properly laminated armatures, generated by both dynamo and motor. That there is a certain amount of power wasted in these currents is quite obvious, though from their tendency to lessen the distortion in the motor, their magnitude, and the consequent waste, is in the motor less.

(To be Continued.)

Wire Construction in Cities.

BY A. A. KNUDSON.

This subject, affecting as it does such a wide range of interest in many cities in this country, is one of the most important at present before the public. In fact it would seem of equal importance to perfecting the dynamo itself to find a suitable place to put the wires. The objections to pole line systems and to underground methods are too well known to need repetition, but the majority of people are not aware that there is any other position in which the wires can be safely and conveniently placed than those above mentioned. It is intended in this article to explain a system which although but little known has received the approval of a number of electricians, and which avoids the objections, so apparent, to pole line and underground conduits. This system is called the Aerial Conduit method.

This means of stringing wires in cities was patented in 1881 jointly by Mr. O. F. Smith of this city and the writer. No pressing demand, however, has arisen for its use until the present time, and while it is now quite likely to be introduced in some of the cities of this country, it would seem proper that it should be brought to public notice.

In construction the plan consists of an ordinary I shaped iron girder enclosed in a sheet iron case in such a manner as to form a conduit with two compartments. Strips of sheet iron are fastened to the top and bottom of the girder extending throughout its length, and sheet iron doors hinged to the bottom strip enclose the sides. The wires or cables are supported on hooks of strap iron fastened to the web of the girder, or more preferably to wooden cleats which have been treated with an insulating material. The conduit is supported on hollow wrought iron pillars from 18 to 20 feet high, placed 60 feet apart, that being the length of the girders, near the curbstone on the sidewalks, about on a line with the gas lamps. The structure is made ornamental, and the smaller size conduit, which is but 6½ by 8 inches, will contain as many as 500 telephone or telegraph wires and 20 or more electric light wires.

Larger sizes of conduit can be easily constructed if required. It will be seen that this small size, placed 18 feet high on small iron pillars four inches diameter, will not look objectionable, while an admirable place is found for the wires. They can neither be blown down by storms nor blown by gas explosions. Instead of hundreds of square feet of space as now taken up by unsightly pole lines, but a few square inches are required. Instead of costly mains being subjected to continual moisture in underground conduits, liable at any moment to fail through the slighest leakage, or the insulation destroyed by heat from steam pipes, or by gas explosions, as has so recently been demonstrated by those on Sixth avenue and other places in this city.

FIG. 2.—OVERHEAD CONDUIT SYSTEM—PERSPECTIVE VIEW.

By referring to the accompanying illustrations a good idea can be formed with but a brief description of the plan and its uses.

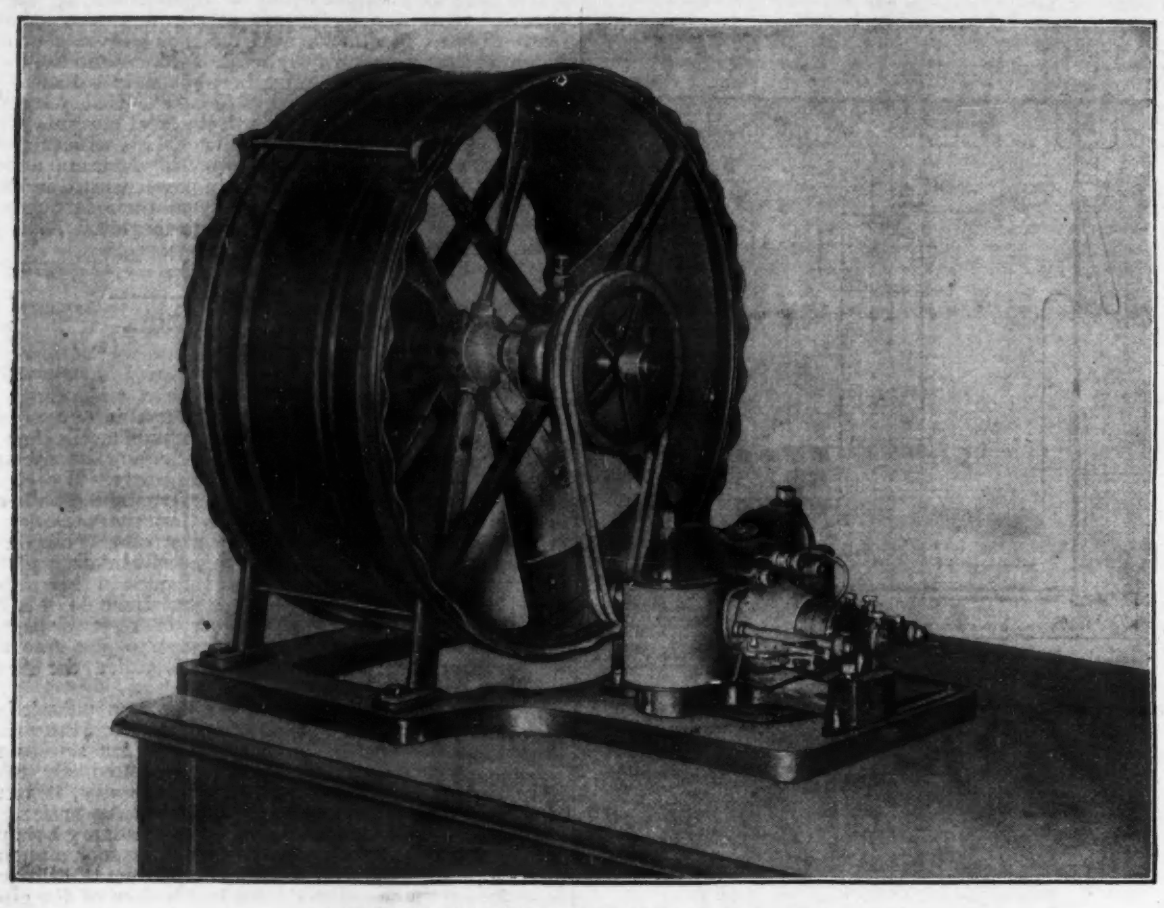
Fig. 1 shows a section as it would appear in the street of a city, with a test box, electric light, and a fire-alarm box on one of the pillars. The wires will terminate in the test boxes, which will act in the same capacity as manholes in the subways, being placed from five to eight blocks apart. In distributing wires from the structure, it is intended to run the wires down the hollow iron pipes just below the flagstones of the sidewalk, thence through a pipe to the basement of such buildings as it is desired to connect. If a street is to be crossed, the mains or cables can be carried from a hole in the top of the pillar to the eaves of a building, thence across the street to the eaves of of opposite buildings, and from there distributed as desired.

Another method of crossing streets by going under the surface of the ground, the wires being inclosed in an iron

pipe, is also shown in the figure. In some cases, in cities where buildings are moved about the streets, this would be more desirable than running overhead.

Figure 2 is a sectional view of the conduit with a portion of a column, showing the iron doors as they are closed on each side. These doors are conveniently let down when wires are to be placed inside, or when repairs are to be made. It will be observed that by this method an important point is secured in the way of accessibility to any part of the line. When wires are to be placed inside, the doors are unlatched and swung down for the distance required, and the wires or cable laid in, thus obviating the necessity of drawing them through conduits, which is so detrimental to insulation, on account of scraping and injury in handling in the confined space of a manhole.

The structure will be convenient on which to place either arc or incandescent lamps, and when once erected will not look objectionable in the streets of any city.



SPRAGUE STATIONARY MOTOR AND FAN.

Combination Sprague Stationary Motor and Fan.

With the approach of summer the question of the best method of ventilating naturally suggests itself, and for that purpose the use of electricity as an agent for transmitting power from a central station to the point of use holds an unrivaled position.

On this page we show a new combination of electric motor and fan which has recently been brought out by the Sprague Electric Railway and Motor Company, and which promises to meet wide-spread demand for a simple and reliable fan, which can be operated directly from a constant potential circuit.

As shown in the view, the motor and fan are both on the same stand, the motor being belted directly to the fan.

The motor, on account of its winding, can be set in operation by the simple movement of a switch, and stopped as easily. There is no necessity of using a rheostat in connection with the motor.

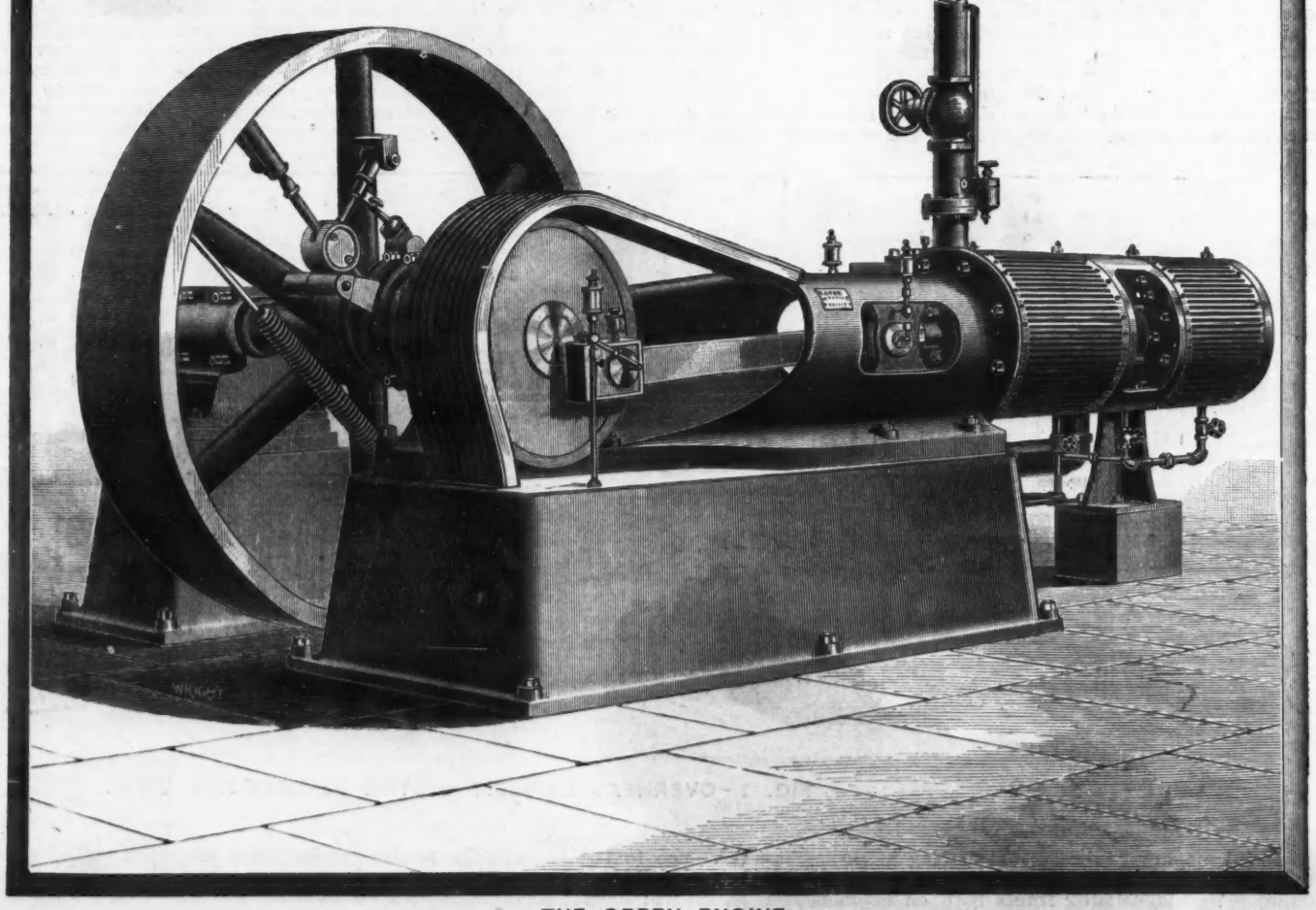
When all the advantages of electric power are taken into consideration—the absence of fire, smoke, ashes, engineer or expert attention—it is not surprising that so many electric motors have been adopted for the general distribution of power, and each new application, like the one illustrated, tends to popularize the use of electric power.

The Green Engine.

Notwithstanding that steam-engine designing has, during the past few years, been gone into most minutely, both theoretically and practically, improvements in regulation and efficiency are yet to be desired in this class of motor.

The engine in the accompanying illustration has been designed with the closest attention to the most recent advances of modern steam-engine building, with a view to obtaining an increased effective power, by reducing the friction of the governor, in its internal parts, and thereby rendering it simpler, more durable, and capable of being run with less attention and greater ease, at the same time maintaining practically constant speed and higher efficiency under varying loads. The engine has been tried with great success in electric light work, which may be considered one of the hardest tests that a steam engine can be subjected to. The bed of the engine is of novel and substantial design, with finished flat top. The head of the bed forms one cylinder head with packing boxes pressed in, admitting of a large hole in the head and the employment of a large stiff bar in the boring of the guides. This also dispenses with one of the cylinder heads, making the alignment more perfect. A hollow piston is used of light weight and packed with spring or snap rings. The cross head is cylindrical, with large working surface in the guides, and fitted with adjustable shoes. The connecting rod is solid forged steel, and presents some new features. The crank-pin boxes are screwed in place by means of a block and bolt, which closes the end of the rod, the boxes being adjusted with a wedge screw. A single set screw is used with the spring under the wedge, which returns the wedge when the screw is backed. The crank shaft is of solid forged steel with counterbalance discs shrunk on. A balance slide valve is employed with but a single moving part covered with a pressure plate and bolted to its side. Steam enters the valve from the inside, and the port which serves as the exhaust in other engines is filled with live steam. This valve has been found to give great satisfaction, and being well balanced and light requires but a small amount of power to operate it. The whole engine appears to be of an eminently practical form, simple in arrangement and well adapted to withstand wear.

This engine was designed by Mr. M. A. Green, and is built by the Altoona Manufacturing Company, of Altoona, Pa.



THE GREEN ENGINE.

Urban Electric Traction.

The following report, signed by Messrs. W. M. Mordey, John Raworth and N. Scott Russell, has recently been published in England, and is here published, not so much on account of its intrinsic value as for the vigorous discussion it has provoked, and because the problems embodied in it point at the possible line of future progress in electrical railroading. The method here suggested is one of many similar ones, but the general plan involved is well worth careful consideration.

"We have lately had an opportunity of examining a scheme which bids fair to solve the problem of electric traction on tramcars without the use of open conduits or accumulators. Mr. Frank Wynne, of 5 Westminster Chambers, is the inventor of the new system, in which power is transmitted from the engine to the car as directly as by rope traction, without the objectionable necessity of cutting a continuous slot in the roadway. Mr. Wynne has been engaged in endeavoring to solve the problem of urban electric tramways for upward of four years. His efforts have been watched with keen interest by engineers and electricians in England, and the skill and foresight with which he has approached the subject has met with general recognition. While electricians and tramway companies in this country have been experimenting with accumulators and slotted conduits, tram lines with overhead conductors have been carrying all before them in America, and excellent commercial results have been obtained. The method of transmitting power to a tramcar by an overhead conductor, though well suited to new and rapidly developing districts, is absolutely inapplicable to English and most Continental cities, and no serious attempt has ever been made to introduce them in this country. Mr. Wynne's new system secures all the advantages of an overhead conductor system without any of the constructive disadvantages of an open conduit. Among the chief advantages of the overhead system are that it enables ordinary permanent way to be utilized without reconstruction for heavier weights, and it allows of existing cars being used with some modifications. These advantages hold to the fullest extent in Mr. Wynne's system, the object of which is to enable the electric current to be transmitted direct from the generating station to the car motors through an insulated cable laid underground, after the manner of electric light cables, with absolute safeguards against the possibility of including any of the ordinary traffic of the street in the electric circuit. The current used is that known as the low-tension continuous current.

"In the centre of the track is laid a crenelated contact plate or rail in short sections. This contact plate or rail is not straight, but is formed to follow the junction line of the sets thus:

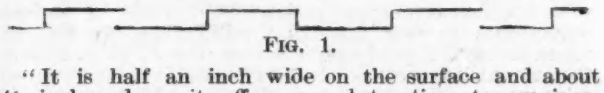


Fig. 1.

"It is half an inch wide on the surface and about 4½ inches deep, it offers no obstruction to carriages crossing the track, and affords a good foothold for horses. Mr. Wynne has invented a remarkably simple device whereby the sections of the centre rail are successively put in connection with the main insulated conductor as the car passes over them, and are disconnected again as the car proceeds. The only sections in connection with the main are those covered by the cars and its platforms; two sections are always in circuit, and a third section may be momentarily so connected as the contact brushes carried by the car pass over one of the separating spaces. The sections are necessarily short, and the inevitable leakage is therefore reduced to quite a neglible quantity.

"The device for making contact with the sections of the central rail is shown in the following diagram (Fig. 1): a, b, c, d are four sections of the sectional contact rail; a_1 b_1, c_1, d_1 are electro-magnets traversed successively by the current passing from the main conductor + to the car

motor *M*. a_2, b_2, c_2, d_2 are armatures and contact makers actuated severally by the electro-magnets, a_1, b_1, c^1, d^1, and are severally contained in the contact boxes a_3, b_3, c_3, d_3. It will be noticed that as the car passes over section *b*, the current passing through the magnetic coil b_1 not only closes the contact in connection with its own magnet b_1, but also puts the magnet a^1 in circuit in parallel with b_1. This arrangement effectually obviates sparking, and provides that one section shall always be charged in advance of the contact brush. The contact pieces assume their original position by gravity, thus disconnecting the sections as the cars leave them. The contact boxes may be placed in any convenient position, as, for instance, in the footway or curbs, but their construction is such as to render them suitable for fixing in the tramway track. The boxes themselves are of cast iron or steel, with a grooved or "diamond" surface, and are constructed on the diving-bell principle, so that the inclosed air will absolutely debar water from rising into the interior.

"It is obvious that it is an essential part of the scheme that the current should never be cut off entirely from the magnets, for under such circumstances they would break contact with the sectional rail, and the car could not proceed. Mr. Wynne has provided thoroughly practical devices both for maintaining the circuit and for re-making it in the event of accidental disturbance—as, for instance, by reason of the car leaving the rails.

"Under ordinary circumstances a small percentage of the current is kept on when the motor has stopped, or when the car may be going down hill. In the event of contact being accidentally broken, the driver, by moving a lever, brings down a supplementary contact brush which closes the circuit of a single cell battery, and so re-establishes the current through the contact boxes.

"There can be no doubt as to the great engineering skill displayed in Mr. Wynne's proposals, the details of which are eminently practical. The contact boxes are numerous, but there is no difficulty of adapting them to work under the conditions of a tramline, and the mere fact of the necessity of their manufacture in large quantities will reduce their cost and tend to simplify their details. This tendency is well illustrated by Lancashire cotton mills, in which 40,000 spindles are often found working all the year round, with scarcely any repairs. We are much impressed with Mr. Wynne's scheme, and consider that it is the only practical attempt that, up to the present, has been made to grapple with the real difficulties of urban electric traction. Batteries are ruinous at present prices, overhead conductors inadmissable in English towns, and open conduits are an aggravation of all the evils attendant on the use of straight rails in crowded streets. Mr. Wynne's invention has none of these drawbacks. We do not think that his crenelated contact rail would be in any way objectionable in well laid roads such as are usually found in London and the principal towns. On the question of the capital cost and cost of power, we have carefully examined the estimates laid before us by Mr. Wynne, after comparing them

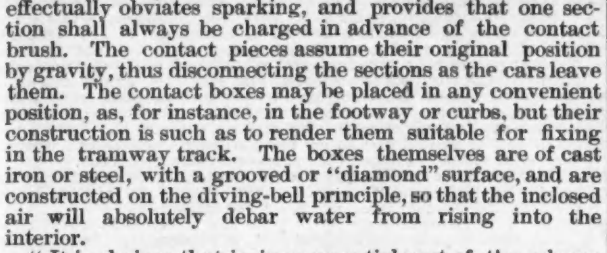


FIG 2.

with data derived from our own experience; and we are of the opinion that they are formed on a good commercial basis, a sufficient margin having been allowed for extras, which are inevitable in carrying out a new scheme. The estimate of capital expenditure for applying this system to an existing tramway amounts to £2,200 per mile of single track; this leaves out the items of real estate and buildings, which will be much less for a line worked by electriicty than for one worked by horses, in which the area of ground and the buildings required for stables and granaries are very large. Against this capital expenditure of £2,200 per mile (including, as it does, boilers, engines and dynamos for twice the maximum power required at any one time) must be set the capital cost of horses and of horse cars, amounting respectively to £1,500 and £500 per mile on the North Metropolitan Tramway, or altogether to a sum nearly equal to that for applying electricity. The large figure of 7½ electrical h. p. per car has been introduced with these estimates to cover a line with steep gradients and so make the estimate of safe general application. American experience shows that this is an ample allowance for the not very marked effect of gradients in increasing the aggregate power required."

The plan suggested is a modification of one which was patented in England by Professors Ayrton and Perry, as far back as 1881. Dr. Hopkinson has employed a similar principle in the patent taken out in 1882, and since that time has been followed in the same field by Wynne, Pollock and Binswanger, Wheless and others. The intention in these various devices has been the same, to secure a practical method of supplying a current to a moving vehicle without employing either conduit or overhead conductor. The bare overhead conductor, although it is to-day used in nearly every electric railway in successful operation, is somewhat limited in its application by the very strong prejudice which exists against allowing bare wires, carrying a potential as high as 500 volts, to be employed in the streets of a large city. For use in towns and open country, the overhead system, for simplicity, cheapness and effectiveness leaves little to be desired, but every electrician who has studied the problem of electric traction and familiarized himself with its details, instinctively looks about for some method which can be applied readily in city streets, and which shall furnish the needed power economically and certainly.

The conduit system has been tried over and over again, on some occasions with considerable success; but the difficulties met have been enormous, and success so difficult of attainment, that as yet the system has not obtained any extensive application.

An open conduit would be very well in a dry, clean street, but street railroads must be operated in all sorts of places; good pavements, bad pavements, and no pavements at all, and the open slot of the conduit is continually receiving contributions of mud, dirt, stones, and debris of various kinds to such an extent that the insulation of the bare conductor in it becomes almost an impossibility, unless the conduit is so large that it can be entered, cleaned, and repaired. In this case the expense is too formidable for ordinary application.

The only other method of supplying power as yet tried for city service, is the storage battery, and although storage battery cars have been and are in successful operation, it does not seem probable that the storage battery can compete in economy with the direct supply system at present.

It is to avoid the necessity of employing the methods of current supply above described, that from time to time systems like the one which forms the text of this article have been proposed. They all have one thing, and one important thing, in common—the division of the working conductor into sections communicating through movable contacts with the main feeding wire, and connected thereto, not all together, but successively as the current is demanded by the cars on the several sections.

It can be laid down as an axiom, probably, that in a city street it would be practically impossible to employ insulated rails charged throughout their whole length, for supplying a current. The insulation practicable in very dry weather, would fail altogether in the conditions to which street railways must necessarily be exposed. Besides this, even if such a track could be insulated, it would be absolutely forbidden by the conditions of city traffic. Consequently, the plan of charging only a section of track at a time, and so making it immensely easier to insulate, appears to be a good way out of the difficulty.

The earliest patent on this subject, that of Ayrton and Perry, seems to be a rather broad one, and suggests various methods for connecting the sectional conductor at the proper time with the feed wire. The latter modifications by their own and other hands, are in the line of devising various automatic means for effecting this connection and perfecting the mechanical details of the system. The fundamental principle is to render the insulation of the rail feasible by charging only a small section of it at once. The various methods for effecting consecutive charging of the various sections over which the car passes are quite numerous, including divers mechanical means, such as plungers pushed down by the wheels of the car and effecting the necessary contacts, and various electro-magnetic methods, some of them depending, like the mechanical one, on plungers pushed down by the wheels of the car; others operating by the rise of potential caused by the car coming on the new section; and still others by batteries placed on the car. In some cases it has been proposed to insulate one of the ordinary rails and use it in the manner above described, but more frequently a third and special rail has been suggested as the most practical form of sectional conductor. Some of the various systems devised, like that of Mr. Wynne, propose also to make the sections of working conductor so short that they shall practically be covered by the body of the car, and hence entirely unobjectionable as regards the interference with the traffic upon the streets. It is quite possible that some one of these various plans may have in it the elements of practical success, and the general lines of improvement pointed out by them is certainly worth following up. None of them have yet been tried on a practical scale, and it must be remembered that no trial can give an adequate idea of the probable success of such a system unless conducted under the conditions met by the ordinary street railroad. A laboratory trial of any one of these schemes is simply worthless as a test of its commercial value. The difficulties to be met are great, for the proper insulation of even a short section of track is no easy matter in a city street. The danger of destructive short circuits is great, for in many situations the tracks are liable to be submerged at any time in water, or covered with slimy mud, which would make insulation well nigh impracticable.

Then, too, in any plan which involves several hundred movable contacts for large currents in a single mile, there are mechanical difficulties to be met which are of a character not likely to be passed over. If eternal vigilance were necessary to keep the contact boxes in order the operation of the system would be a constant source of trouble and annoyance, and every electrician knows only too well that even the best automatic apparatus is liable to fail.

If these two difficulties can be successfully overcome; if the rail sections can be insulated well enough to avoid excessive loss and frequent short circuits; and if the numerous contacts required can be made to work with unfailing regularity and without the necessity of frequent inspection and repair, it may be that some one of these systems will develop into a really successful method for city rapid transit. The difficulties are formidable but not prohibitive, and on the whole the general plan is of considerable promise.

It is to be hoped that some of the inventors interested in the various modifications of the scheme will put their several methods to a practical test; not a test in a laboratory, or in the back yard of some electrical manufacturer, but on a section of city street where they would meet with practical difficulties instead of theoretical ones.

It is quite probable that some modification of the principle involved might be applied successfully to improving the insulation of the conduit system, thus making it possible to employ a smaller and less expensive conduit, and to keep its insulation up to a practical figure.

Development along the line of rapid transit for cities is so very desirable that the incentive to work out a successful system is great.

As to the individual merits of the system which provoked this discussion, it is not, perhaps, worth while to speak until it shall have been put to a practical test. One would anticipate, however, some trouble in securing good movable contacts along the line of a crenelated conductor such as it is proposed to employ. So far as yet discovered, railway tracks are not placed in the streets so much for the purpose of facilitating the transit of miscellaneous vehicles as for allowing the passage of street cars, and unless the peculiar form of conductor described is demanded by the authorities, it is hard to see any advantage which can follow its use.

The State Senate Committee on General Laws' Electrical Investigation.

The State Senate Committee on General Laws met at the Hotel Metropole on the 17th inst. There had been a lively altercation at the previous meeting on the 15th between Chairman Erwin and Mr. Bliss, who appeared ostensibly as a citizen, but virtually for the Edison interests, with relation to the placing of a witness on the stand as to whose professional status and fitness to give testimony the chairman was not quite clear. The senators had then gone into executive committee and decided that the witness should testify. When, therefore, the committee took their seats on Monday morning, it was expected that pretty close cross-examination of the witness would be the order of the day. Senator Coggeshall was elected to the chair and stated that Senator Erwin had been called away on important business. He then went into a lengthy explanation of the situation with reference to Mr. Bliss, and stated that that gentleman should no longer appear before the committee. He said if Mr. Brown liked to go on the stand he could do so, and notice to that effect had been conveyed to him. The committee waited until twelve o'clock, and as the proposed witness had not then put in an appearance, the meeting adjourned subject to the call of the chair.

The New Electrical Department at the Brooklyn Institute.

Further steps were taken to organize the new electrical department at the Brooklyn Institute on the 21st, when the Institute lecture hall was filled by an intelligent and earnest audience. Professor Franklin W. Hooper was appointed chairman of the meeting, and Dr. F. H. Cotton, Secretary. After referring to the inducements which had led to the calling of the first meeting a fortnight ago, Professor Hooper read the Constitution which the special committee appointed for that purpose had prepared. The constitution sets forth that systematic courses of lectures will be given, accompanied by experimental demonstrations on electricity; that a laboratory equipped with all the appliances necessary for electrical measurements and for the study of electric and magnetic phenomena shall be provided and placed at the disposal of the members of the department, and that regular meetings will be held for the presentation and discussion of electrical questions.

The names suggested as members of the various committees include many well-known electricians, and give an excellent indication of the strength and scope of the new departure of the Institute. The names, which will be voted on at the next meeting, are as follows:

Committee on Application of Electricity in Surgery and Medicine—Drs. E. H. Bartley, A. H. Buckmaster, H. Arrowsmith, B. F. Westbrook, Joseph Raymond and Nathaniel Robinson.

Committee on Electro-Metallurgy—Prof. A. K. Eaton and Charles Taylor.

Committee on Telegraph and Telephone—J. C. Reilly, J. N. Weirs, W. D. Sargent and E. R. Knowles.

Committee on Electric Power—J. Stanford Brown, William Hockhausen, F. V. Henshaw, William A. Mosscrop, R. W. Bayles, Edward Brown and Frank A. Perret.

Committee on Electric Lighting—G. W. Hebard, W. S. Barstow, E. J. Cook, E. F. Peck and J. T. Woodbridge.

Committee on Laboratory and Apparatus—Profs. Dan'l. W. Hering, William C. Peckham and Samuel Sheldon, Spencer C. Wyckoff and Dr. P. H. Van der Weyde.

Committee on Electrical Standards—Profs. Robert Spice, William W. Share and Geo. W. Plympton, William L. Barstow, John A. Barrett, W. D. Sargent and Thomas Cochran.

Prof. Hooper announced that Prof. Spice will deliver a course of lectures on the subject of electrical measurements. The first lecture will treat of the plan on which electrical measurements are based; the second, on the instruments with which electrical measurements are made; the third, on the units of electrical measurements; the fourth, on Ohm's law; the fifth, on the measurement of resistance, and the sixth, on the strength of current and the usage of current. This course has just been given at the Cooper Institute and has been attended by several hundred people.

The chairman made another statement which roused the audience to enthusiasm, viz.: That Dr. P. H. Van der Weyde has presented to the Electrical Department of the Institute his entire laboratory outfit, numbering about five hundred pieces, and valued at several thousand dollars. The Electrical Department thus finds itself fully equipped with apparatus and in a position to begin active work forthwith.

The chairman then introduced Prof. Samuel Sheldon, who delivered a lecture on "The Requisites of Good Batteries."

The lecture throughout was lucid and full of interest, and was an excellent augury for the class of work the Institute has set itself to carry out.

Prof. Spice's course of lectures will be delivered on Saturday nights, commencing on the 29th.

Final Decision in the Kemmler Case.

Judge O'Brien, of the Court of Appeals, rendered its decision in the Kemmler case, March 21. The court was unanimous in affirming the constitutionality of the Electrical Execution law. Following is the text of the decision:

"The relator, being in the custody of the respondent, agent and warden of the State prison at Auburn, applied for a writ of habeas corpus to inquire into the cause of his detention, which was made returnable by the officer granting it before the County Judge of Cayuga County. The relator, in his petition for the writ, stated that the cause or the pretense of the imprisonment complained of was that after his indictment and trial for the crime of murder in the first degree and his conviction thereof in the Court of Oyer and Terminer, he was sentenced by that court to undergo a cruel and unusual punishment for that crime, contrary to the Constitution of the State and of the United States, and was threatened with deprivation of life without due process of law by reason of such illegal sentence and judgment of the court. The writ was duly severed upon the respondent, who made return thereto that he detained the relator in his custody by virtue of the judgment of the Court of Oyer and Terminer held in Erie County, whereby the relator was duly convicted of the crime of murder in the first degree, and also by virtue of a warrant duly delivered to him under the hand and seal of a Justice of the Supreme Court presiding at the said Court of Oyer and Terminer, whereby the relator was convicted, which recited the indictment, trial, conviction and sentence of the relator, and directed the respondent to carry the same into effect. This command and direction to the warden was in accordance with the sentence actually passed upon the relator after conviction. On the return day of the writ the relator and respondent appeared by counsel before the County Judge, and by agreement of counsel, the production of the relator, pursuant to the command of the writ, was waived.

"Counsel for the relator then offered to prove that the infliction of the penalty named in the sentence—namely, death by the application of electricity—is a cruel and unusual punishment within the meaning of the Constitution, and cannot, therefore, be lawfully inflicted. The Attorney General objected on the ground that the court had no authority to take proof in regard to the constitutionality of the statute. This objection was overruled by the County Judge, and the counsel for the respective parties agreed that a referee be appointed for the purpose of taking the testimony in pursuance of the offer. The result was that after a hearing upon the report of the referee, the County Judge dismissed the writ and remanded the relator to the custody of the respondent. When it appeared from the return of the respondent that he detained the relator in custody under and by virtue of a judgment of a court of competent jurisdiction wherein the relator was convicted of murder, it was the duty of the county judge to dismiss the writ and remand the relator to the custody of the warden of the prison unless it could be shown that the Court of Oyer and Terminer was without jurisdiction to pass the sentence which it did. (People ex. rel. Fry vs. Warden, etc., 100 N. Y., 20; People ex rel. Tweed vs. Liscomb, 60 N. Y., 559.) It is not denied that the court had such jurisdiction, providing that the Legislature had power under the Constitution to enact chapter 489 of the laws of 1888, relative to the infliction of the death penalty.

"Prior to the passage of this statute the punishment by death in every case was to be inflicted by hanging. This provision of law was changed by the amendments of the code above referred to, and now the law commands the infliction of the death penalty by electricity. The only question involved in this appeal is whether this enactment is in conflict with the provision of the State Constitution which forbids the infliction of cruel and unusual punishment. (Con., Art. I, 35.) This provision was borrowed from the English statute passed in the first year of the reign of William and Mary. It enacts that 'excessive bail ought not to be required, nor excessive fines imposed, nor cruel and unusual punishment inflicted.' When this statute was made part of the Constitution of the United States the word 'shall' was substituted for the word 'ought,' and in this form it first appears in the Constitution of this State, adopted in 1846. It is not very clear whether the provision as it stands in our Constitution was intended as an admonition to the Legislature and the Judiciary, or as a restraint upon legislation inflicting punishment for criminal offenses.

"When the statute referred to was enacted in England it was not intended as a check upon the power of Parliament to prescribe such punishment for crime as it considered proper. Its enactment did not deny any law then existing, nor did it mitigate the hardness of criminal punishment in that country. For more than half a century after it appeared on the statute book a long list of offenses

were punished by death, many of which had not been so punished before the Bill of Rights was passed, The ascension to the throne of a new Prince was the cause of the enactment of the new law, and it was simply a declaration of the way the people wanted the government to run. But, whatever its origin, we think that its presence in the Constitution of the State confers power upon the court to declare null and void legislative acts prescribing unusual and cruel punishment in fact. This is the power invoked against the amendment to the Code of Criminal Procedure above referred to by the counsel for the relator. It is interesting because of its great research. The power of the Legislature over crimes and punishments cannot be disputed.

"The amendment prescribes no new punishment for this offense; the punishment is death., as heretofore, the only change being in the mode of carrying it out. The death penalty must be accompanied by pain, and is resorted to only because it is necessary for the protection of society. The relator attempts to show that the new mode is torturous. The argument would apply with equal force to any untried method, and, if carried out, would prohibit the death penalty. Every act of the Legislature must be presumed to be in harmony with the fundamental law until proved contrary. The testimony of experts is not admissible to show that some clause of the Constitution is violated. If the act on its face is in conflict, then extraneous proof cannot be brought in."

The decision recites the appointment of the commission to investigate a humane method of death punishment and the enactment of the electric statute, and says:

"The Legislature proceeded with care and caution and with unusual deliberation. It would be a strange result if it could be now changed and held that they had obtained a more cruel method. Whether or not electricity is more humane was a question for the Legislature alone to determine, and they had more chance of so determining than an appellate court.

"The decision of the Legislature is conclusive upon the courts. The amendment to the code making the new penalty, is not in general purpose or intent a violation of any provision of the Constitution. The testimony taken by the referee, while not impeaching the validity of the Legislature's acts, is a valuable collection of opinions, but nothing more. The court finds that the mode proposed is not cruel within the meaning of the Constitution, though unusual. On the contrary, all agree with the court below that it removes every reasonable doubt that the application of electricity to the vital parts of the human body under such conditions and in the manner contemplated by the statute, must result in instantaneous, and, consequently, painless death. The order appealed from should be affirmed."

Judge Coxe's Brush-Julien Secondary Battery Decision.

UNITED STATES CIRCUIT COURT, SOUTHERN DISTRICT OF NEW YORK.

The Brush Electric Company vs. The Julien Electric Company, et al In equity.

COXE, J.

This is an equity action for the infringement of four letters patent, granted to Charles F. Brush, for improvements in secondary batteries, and now owned by the complainant. These patents are numbered and dated as follows:

Nos. 337,298 and 337,299, were applied for June 13, 1881, and were granted March 2, 1886. No. 260,654 was applied for June 13, 1881, and was granted July 4, 1882. No. 266,090 was applied for June 9, 1881, and was granted October 17, 1882.

The first of these, No. 337,298, which is distinguished as Case I. relates to secondary batteries, and consists in a plate or support provided with a mechanically applied coating of absorptive substance to be transformed into an active coating. Also, in a plate or support provided with a mechanically applied coating of granulated, spongy, or porous metallic lead. It further consists in the method of constructing plates for secondary batteries, consisting in mechanically coating lead, or other suitable plates, with an absorptive substance adapted to be transformed into an active coating. The drawings attached to the specification represent the supports in various forms. They show plain, studded, honey-combed, corrugated and ribbed plates; plates with angular corrugations, arranged singly or in pairs, and plates with slots or perforations extending through the plates. The active material consists of granular, porous or spongy lead, which is held in position upon the plain plate of lead by a sheet of heavy paper, card-board, cloth or felt, which may be secured to the plates by rivets, ties, or binding strips of wood or metal. The paper or felt may be dispensed with, and the spongy lead held in position on both sides of the support by subjecting it to pressure, hydraulic or otherwise. In the corrugated, grooved, ribbed, perforated, studded or cellular plates the spongy lead may be held in the grooves, cells, or cavities by paper or felt, or it may be rammed or pressed into them.

The specification states that "when a pair of plates are associated together to form a secondary battery, and immersed in dilute sulphuric acid and charged by the passage of an electric current in the usual manner, one of the plates absorbs a large quantity of hydrogen, while the other plate has its spongy or granular portion peroxidized, and thus forms the oxygen element in the battery."

The claims alleged to be infringed are the first, fifth, eighth, tenth and eleventh. They are as follows:

"1. A suitable plate or support provided with mechanically-applied absorptive substance and adapted for use as a secondary battery element or electrode after being rendered active by an electric current, substantially as set forth.

"5. An improvement in the construction of a secondary battery element or electrode, said improvement consisting in a plate or suitable support provided with grooves, receptacles, or perforations primarily coated, combined, or filled with mechanically-applied absorptive substance, substantially as set forth.

"8. In the process of making plates or elements for secondary batteries, primarily and mechanically applying or combining with a suitable plate or support an absorptive substance adapted to be transformed into active material, substantially as set forth.

"10. In the process of making a secondary battery plate or element, combining by means of pressure an absorptive substance and suitable material to form a support therefor, substantially as set forth.

"11. In the process of making a secondary battery plate or element, constructing a suitable plate or support with grooves, cells, receptacles or perforations, said plate or support having an absorptive substance primarily applied thereto or combined therewith, substantially as set forth."

The second, No. 337,299, which is distinguished by the inventor as Case J, is for the same invention, substantially, as Case I. The drawings of the two are identical and the language of the specifications is very similar; where it differs, equivalent expressions are employed.

Perhaps the principal differences are the substitution of the words "active material" for the expression "absorptive substance adapted to be transformed into an active coating," of Case I, and the words "lead oxide" for the "granular or porous lead," of Case I.

The specification in question contains this additional statement:

"Peroxide is the best oxide of lead to use in the preparation of the plates; but as this is rather expensive to prepare, red lead or minium may be used. Some sulphate of lead is liable to be formed when this oxide of lead is employed, by the section of the sulphuric acid of the battery on it before peroxidation or reduction is effected. Protoxide of lead or litharge may also be used, but is objectionable, on account of the large quantity of sulphate of lead which is unavoidably produced by the action of the acid on it."

And also the following:

"I would have it understood that I do not restrict myself to any particular form of active or absorptive material, or to any particular method of applying it to or combining it with the plate or support, as my invention consists, broadly, in a secondary battery plate or element having active or absorptive material primarily and mechanically applied thereto or combined therewith, as contradistinguished from a plate or element having the active material produced by the disintegrating action of electricity, as in the well-known Planté process."

The claims alleged to be infringed are the first, second, third, sixth, seventh, eleventh, twelfth and thirteenth. They are as follows:

"1. A secondary battery element or electrode consisting of a plate or suitable support primarily coated or combined with mechanically applied active material or material adapted to become active, substantially as set forth.

"2. In a secondary battery, an electrode consisting of a plate or support provided with a coating or surface layer of an absorptive substance, such as metallic oxide, applied thereto, substantially as set forth.

"3. A plate or suitable support primarily coated or combined with mechanically-applied oxide of lead or equivalent lead compound, substantially as set forth.

"6. A plate or suitable support provided with grooves, perforations or receptacles, and primarily coated, combined or filled with mechanically-applied active material or material adapted to become active, substantially as set forth.

"7. A plate or suitable support provided with grooves, perforations or receptacles, and primarily coated, combined or filled with mechanically-applied oxide of lead or equivalent lead compound, substantially as set forth.

"11. In the construction of secondary battery elements or electrodes, a plate or suitable support primarily coated or combined with mechanically-applied red lead, substantially as set forth.

"12. The method of making plates or electrodes for secondary batteries, consisting in primarily combining active material with suitable plates or supports mechanically, in contradistinction to forming the active material by an electrical disintegration of the plate or support, substantially as set forth.

"13. The method of making plates or electrodes for secondary batteries, consisting in coating the plates or supports with red lead prior to their immersion in the battery fluid, substantially as set forth."

These two patents, Nos. 337,298 and 337,299, are fundamental patents designed to cover the broad inventions of Mr. Brush.

No. 260,654 is a division of Case J and is distinguished by the inventor as Case J, Division A.

The invention "consists in the method of making the plates of a secondary battery consisting in forming receptacles for oxide of lead in its surface, then applying oxide of lead to the plates and within such receptacles and afterward subjecting the oxide of lead to pressure."

The drawings of this patent are identical with those of the preceding patents, except that Fig. 1, showing the use of card-board or felt, is omitted.

The specification contains the statements above quoted from Case J, relative to peroxide being the best oxide of lead to use, and says, further, that the oxide of lead may be retained in place by being rammed or pressed into its receptacles, cells or grooves.

The single claim is as follows:

"The method of forming the plates of a secondary battery, consisting in forming receptacles for oxide of lead in its surface, then applying oxide of lead to the plate and within such receptacles, and afterward subjecting the oxide of lead to pressure."

In No. 266,090, distinguished as case C, the invention consists in a secondary battery element, constructed of cast-lead or other suitable substance, having cells, receptacles, ribs or projection in its surface, whereby an extended surface of metal is exposed to action.

The drawings are the same as those attached to the preceding patents, with some new ones added, showing the plates arranged ready for charging.

The specification says of Fig. 4 that it shows a modified form of ribbed plate resembling an ordinary window-blind with the slats open. It may also be regarded as a thick plate perforated with a series of parallel slots. And of Fig. 5, that it shows the honey-comb form of plate, resembling in construction a simple or double comb of beeswax. It may have its cells extending entirely through the plate.

The plates may be made by pressing plain sheets of lead or other suitable metal into dies or forms by hydraulic or other means, also by slotting, punching or otherwise perforating suitable plates, and also by casting the melted metal into suitable molds.

The claims alleged to be infringed are first, third, fourth, fifth, sixth, seventh, eighth, ninth, twelfth, and fourteenth. They are as follows:

"1. In a secondary battery, an element or electrode made up of a series of ribs, substantially as and for the purposes set forth.

"3. A secondary battery element or electrode having its body support or frame provided with ribs.

"4. In a secondary battery, the combination, with one cell thereof of two or more ribbed plates or elements, substantially as set forth.

"5. In a secondary battery, a plate, frame, or other sustaining body provided with ribs or their equivalent, of a less general thickness than the said plate or support, substantially as set forth.

"6. In a secondary battery, a plate, frame or other sustaining body provided with ribs or their equivalents, said ribs or their equivalents being thicker at their bases than at their free edges or ends, substantially as set forth.

"7. A secondary battery element or electrode having its frame, support or body provided with cells or cavities, the walls of said cells or cavities, or the septa, between them having an increasing thickness from their outer or free edges inward.

"8. In a secondary battery, plates or elements provided with comparatively thin ribs, or their equivalents, for surface exposure, and thicker ribs suitably disposed for supporting or stiffening purposes, substantially as set forth.

"9. A secondary battery having a body frame or support of cast-lead.

"12. A secondary battery element or electrode having a supporting body or frame of cast-lead for the active coating or substance, said body or frame provided with ribs or projections

"14. A secondary battery element or electrode having a supporting body or frame of cast-lead for the active coating or substance, said body or frame provided with slots, perforations, or openings."

The defendants have made, used and sold secondary or storage batteries composed of a series of electrodes, consisting of a cast metal support plate, 96 per cent. being metallic lead, and an exterior spongy or porous coating of mechanically applied active material consisting of lead oxides. These electrodes are placed in an electrolyte of dilute sulphuric acid in water. The charging current converts the lead oxide coating upon the oxygen plates into peroxide of lead and reduces the lead oxide coating upon the hydrogen plates to the condition of spongy or porous metallic lead. The battery is capable of numerous charges and discharges, in the course of which the active material undergoes successive reductions and reoxidations. The lead oxides used consisted generally of minium and litharge, the former largely predominating in the mixture applied to the oxygen plates and the latter predominating in the mixture applied to the hydrogen plates

The defenses to all of these patents are anticipation, want of novelty, lack of invention, abandonment (except of No. 260,654), and that the claims have been fatally broadened. As to cases I and J, it is said that the scope of the original applications had been unlawfully enlarged; that the patents expired with an Italian patent to Brush containing the same invention, and, finally, that they are for the same inventions, and that one of them is, therefore, void.

It is also insisted that No. 266,090 is limited by the Italian patent. Invalidity and non-infringement of several claims are alleged.

Are cases I and J for the same invention, and, if so, what course should be pursued regarding them? It will simplify the controversy to answer this question at the outset.

As stated above, the drawings of the two patents are the same, and the language of the specifications and claims are substantially alike upon all matters material.

The contention of the complainant is that Case I is for a secondary battery support mechanically coated with an *absorptive material*, and Case J for a similar support coated with an *active material*; "the distinction between the two relating to the condition and inherent capacity of the material of the coating as that material exists at the time of mechanical application." For instance, the spongy lead of Case I has, it is said, no oxygen and is initially absorptive and inactive, while the peroxide of Case J is a fully saturated oxygen compound and is, therefore, active and non-absorptive. It is admitted that the moment a battery, constructed with plates having either coating, is charged or discharged, all distinction vanishes.

"The fundamental distinction between these patents," says the complainant's brief, "is that in the former the coatings of the secondary battery electrodes, are, broadly, mechanically-applied *absorptive substance*, while in the latter these coatings are that class of mechanically-applied absorptive substance defined as active material."

Therefore, both patents, it is argued, are valid

This question, though it is an accurate statement of the difference between the two, would seem quite tantamount to an assertion that a party may have a patent for a device composed of a combination of iron and wood and a second patent for the same device composed of iron and basswood or hemlock.

One who has a patent for a combination, one element of which is an adhesive substance, may not have a second patent for a combination, identical in every respect, except that the adhesive material suggested must be moistened before it becomes adhesive.

The coatings of both patents being absorptive and active, is the fact that one, prior to immersion in the electrolyte, *has* absorbed, and that the other *will at once* absorb, a sufficient dissimilarity upon which to base invention? Is it a patentable distinction? The difference is one which would hardly occur to a practical electrician, and even specialists enthusiastic in the cause of the patent find it difficult to state it in words which are intelligible to ordinary men. It is too esoteric, metaphysical and minute. It is a mere theory of the scientists, and not a fact upon which to found a patent.

The essence of Brush's broad invention was an improvement upon the secondary batteries of Planté, by adding the porous layer mechanically to the supports, in the manner described, instead of forming it by the tedious and inefficacious process of disintegration in the body of the plates themselves. When he is thoroughly protected in this invention he has received all that he is entitled to. By taking two patents he should not be permitted to multiply claims which could not stand side by side in one and the same patent.

There seems to be little controversy that *absorptive substance* and *active material* are used in the art as synonymous and equivalent terms, and have been so used since the time of Planté. The inventor, himself, apparently so understands it, for he has frequently used them interchangeably, not only in his testimony, but in the patent (Case J) itself.

Prof. Barker says: "To a person skilled in the art, as it seems to me, the terms are only different forms of expression for one and the same thing. A secondary battery electrode, such as is contemplated in these patents, can consist of but two essential parts: (1) the material of the coating which gives to the battery its usefulness, and to which is due its capacity of storing electrical energy, and (2) the conducting frame or support upon which this material is spread. Since upon the former the action of the secondary battery depends, it has become the general practice to speak of it as the "active material" of the electrode, in contradistinction to the support of the plate itself, which is or should be inert. The function of the coating is to change its chemical condition, as, for example, its state of oxidation, so far as to vary this condition in one direction in charging and in another on discharging. . . . Since, in my judgment, granular, porous or spongy lead, the substance of the first patent is 'active material or material adapted to become active' in the words of the second; and since the oxides of lead of the second patent 'are absorptive substances adapted to be transformed into an active coating' in the first, I am of the opinion that the 'absorptive substance' of the first patent and the 'active material' of the second are to be understood as equivalent terms." The court is fully satisfied that this conclusion is correct.

The identity of the two patents can best be illustrated by placing similar claims in juxtaposition; the first claim of Case I, and the first and second claims of Case J, for instance:

Case I.	Case J.
1. A suitable plate or support provided with mechanically-applied absorptive substance and adapted for use as a secondary battery element or electrode after being rendered active by an electric current, substantially as set forth.	1. A secondary battery element or electrode consisting of a plate or suitable support primarily coated or combined with mechanically-applied active material or material adapted to become active, substantially as set forth. 2. In a secondary battery an electrode consisting of a plate or support provided with a coating or surface layer of an absorptive substance, such as metallic oxide, applied thereto, substantially as set forth.

There can be no question, if "absorptive substance" and "active material" are equivalent terms, that these claims are for the same invention. Each has the following elements: (1) A secondary battery support plate, (2) mechanically coated with (3) an absorptive or active material.

The question, then, is, Can a patentee who has received a patent for a plate coated with absorptive substance obtain another patent for the same plate coated with active material? Can an inventor obtain two patents for a broad invention because in one he practices the invention with one substance, and in the other he practices it with an equivalent substance? Manifestly not!

After Case I no one could have a patent for Case J, even if confined solely to the points wherein the two are said to differ. The former includes the latter. I am constrained to say, therefore, that the two patents are, in legal contemplation, the same. Although the possibility that the court might reach the conclusion was stated at the argument, neither counsel offered any solution of the difficulty and none has been offered since. The situation is certainly an unusual one. Here are two patents for the same invention applied for at the same time and granted at the same time. It is true that no injury can result in this particular instance, but what would be the situation if one of these patents were owned by a third party and a suit were brought on it against the defendants for the same infringement, or if the second patent were granted years after the first? If the principle is once established that an inventor can, by such inconsequential changes as here are shown, obtain two patents for the same invention, the greatest injuries may be done, both to competitors and to the public.

It would seem that the inventor had given Case I the preference; and as his expert regards that as the broader of the two patents, the difficulty might be met by a surrender of Case J, or perhaps by a disclaimer of similar claims in Case J, leaving those which have not been brought into controversy or considered, and, possibly, the red lead claims, to stand. But, as neither counsel has expressed his views on this subject, the method of carrying out the opinion of the Court can best be arranged on the settlement of the decree.

Many of the propositions now advanced were examined and decided, upon identical testimony, by this Court, in the case of The Electrical Accumulator Company vs. The Julien Electric Company et al, 38 Fed. Rep. 117. These need not be again considered.

A definition of a secondary battery was there attempted and is now adopted for the purpose of this controversy. When the present inventor refers to secondary battery he means precisely what Mr. Faure meant when he used that term.

It was further decided in the Accumulator case, that the exhibits which were the closest approximations to the invention were the article from the *Electrician* of 1883, the report of the Smithsonian Institution for 1856, the Grove gas battery, Planté's descriptions of 1872, and the patents to Kirchhof and Percival. Faure's claim, before being limited by a disclaimer, was broad enough to cover a secondary battery electrode to which the active material was applied, not only mechanically, but by galvanic action, chemical precipitation or in any other way, so that it was not formed out of the plates themselves in the manner described by Planté.

The evidence referred to, together with the testimony of Mr. Brush, was regarded as sufficient to limit the Faure invention to the application of the active material in the one form described by him, namely, as a paint, paste or cement. What effect the evidence disclosing the prior art had upon the patents in suit was, of course, not directly considered.

In the complainant's brief considerable space is devoted to the establishment of the proposition that Brush was, in legal contemplation at least, prior to Faure. It is thought that a discussion upon this point is unnecessary. The precise question was presented and decided in the interference proceedings before the Patent Office and in the Accumulator case. The defendant's counsel having there contended that Brush anticipated Faure, recognizes the impropriety of now contending that Faure anticipates Brush, and merely submits the testimony in this behalf without comment. The decision heretofore made upon the same state of facts will, therefore, be adhered to.

It was there decided—although the date was not definitely fixed—that Faure, being a citizen of France, and having conceived his invention in a foreign country, was not permitted to claim it here earlier than the date of the delivery of his French patent—Dec. 7, 1880. Faure's contributions to the art need not, therefore, be considered in this action.

The proof now offered to establish invention was carefully examined in the Accumulator case, and it was held that "the evidence of Mr. Brush as to what he accomplished in 1879 and 1880 must be accepted as true."

What did Brush accomplish?

A history of his experiments and their results is given at length in the other case (pages 129, 130, 131), and need not be again repeated. In brief, it is this: In the summer of 1879, he made secondary battery electrodes, by applying to suitable plates an active or absorptive coating consisting in three instances, respectively, of metallic lead in the form of a fine powder, red oxide of lead, and litharge. These coatings were held in place by a piece of blotting paper, a strip of wood and a string wound tightly around the whole. In July, 1880, he made lead plates with deep grooves; into the grooves of some he rammed yellow oxide of lead and in others sulphate of lead. In September, 1880, he made six plates grooved by a gang of circular saws, and filled the grooves of two by ramming them full of litharge, and of two others by ramming them full of sulphate of lead. The electrodes thus constructed operated successfully in secondary batteries and produced satisfactory results.

Many other structures leading up to the invention were made, but it is not necessary to consider them in detail. It may be said, however, that from the time the idea first entered his mind until the applications were filed, Mr. Brush was engaged, almost constantly, in progressive experiments and investigations.

For the reasons stated in the Accumulator case it is thought that this invention is not anticipated by the testimony of Professor Van der Weyde, the article from the *Electrician*, the Smithsonian report, the Grove battery, or the patents to Kirchhof or Pulvermacher (39 Fed Rep. 490).

It was said of the patent granted to George C. Percival, April 3, 1886: The idea of Percival also, as shown in his United States Patent No. 53,668, was to improve on Planté's method by saving time and expense. He describes a secondary battery consisting of one pair of electrodes placed in a water-tight wooden box, divided in its centre by a porous partition. On each side of this partition is a layer of powdered gas carbon. These layers constitute the two electrodes, and when in use they are wet by a proper solution. For convenience in establishing connection with these layers there is on each end of the box a screw cup fastened to a strip of copper which is in contact with the carbon. "Lead or any other suitable metal in the form of a coarse powder may be substituted for the gas carbon. This appears to be somewhat analogous to some of the forms described by Faure. The complainant contends that the reference is valueless for the reason that there is no suggestion of a conducting support plate like Faure's, which holds the active layer and conducts electricity to each and all parts of it so that the whole material instantly becomes spongy and thus capable of receiving and discharging electricity. In short, that the Percival battery is without the Faure support plates." (Accumulator case, 38 Fed. Rep. 126.)

It is argued that this patent is an anticipation of claims 1 and 8 of Case I. This is probably true, if a very broad construction is placed on these claims, but there is nothing in the record requiring such a construction. There is no evidence that a Percival battery was ever used or could be made operative. His invention does not seem to be on the line subsequently followed by Brush. He has no plate or support at all resembling those of the Brush patents. He has no *coatings*. His two copper connecting slips *support* nothing. The pulverized gas carbon is not mechanically applied to them; they are simply in contact with the gas carbon. Their presence is not necessary; they are put there for greater convenience only. Percival's electrodes are not coated supports at all; they are cells filled with coarse conducting powder and divided by a porous partition.

Percival's claim is for:

"The forming of the electrodes of a secondary pile of layers of gas-carbon or some other conducting powder, substantially as, and for the purpose herein before described."

Is it not clear that he did not have in mind a lead, or other suitable plate with a layer or coating of active material mechanically applied thereto?

It would seem, then, that nothing in the record anticipates the Brush patent, Case I, when a construction commensurate with the invention is placed upon it.

He did not invent secondary batteries or electrodes for such batteries having a layer of active material, or the use therein of a conducting powder, but he seems to have been the first in this country who held the absorptive substance, in the form of dry powder, in place on the supports by paper or equivalent material, and the first who rammed or pressed it into grooves or receptacles in the plates.

The invention of Case I was not abandoned by descriptions in Patents No. 261,512 and 261,995, granted to Mr. Brush, respectively, July 18 and August 1, 1882.

There is no evidence as to when the applications for those patents were filed, other than the date appearing upon the specification, and this would seem to be insufficient proof of the fact. But accepting this date, June 29, as the true one, only four days elapsed before the filing of the application of Case I—June 13.

The inventor was not responsible for the delay in the Patent Office, which was occasioned by interminable interference proceedings between him and other inventors. His intention not to abandon is demonstrated by the fact that the application for the patent in suit was made out and sworn to two days before the application for the prior patents were filed.

In Holmes vs. Alarm Company, 33 Fed. Rep., 254, this Court decided that where a patent fully describes an invention which could be claimed therein, and makes no reservation and gives no warning to the public, a second patent granted upon an application filed months after the first patent was issued, which claims simply the invention previously made public, is invalid. But the Court also used the following language, which seems quite applicable here:

"This is not the case of a patentee who has made application for the second patent before the first is issued. It would be manifestly unfair to hold him responsible for the action of the Patent Office in this regard."

It is thought no authority can be found holding an invention abandoned upon such facts as are here developed. I should be sorry to make a precedent now which can have little but the most technical reasoning to support it.

The patent is not invalidated by the introduction of the descriptive term "absorptive substance" after the original application was filed. The claims as originally stated use the language "mechanically applied porous, granular, spongy or equivalent lead." The claims as issued substitute the words, "mechanically applied absorptive substance." This did not change the invention. It was the employment, simply, of more apt and artistic terms for the comparatively clumsy language of the original.

It is argued that claims 5 and 11 of Case I have been unlawfully expanded by the insertion of the word "perforations" therein. Neither the specifications, claims or drawing, as originally filed, mention perforations extending through the plate. They first appear in an amendment filed June 1, 1882.

Prior to this, in the summer of 1881, Prof. Eaton had made perforated secondary battery plates. (Accumulator case, 38 Fed. Rep., 141.) John S. Sellon and Joseph Wilson Swan had described similar plates in their patents of March 10, 1882, and Nov. 22, 1881, respectively.

It is not contended that Mr. Brush ever made such a plate. There is no proof that he did, and he testifies that he cannot recall having done so.

The value of perforations extending through the plate seems to be conceded. Proof of the advantages of this construction appears in the record and the language of Sir William Thomson, who testified in the previous case, may be adopted as an epitome of what is affirmed by the witnesses here. (See Accumulator case, 38 Fed. Rep., 140.)

The complainant's brief contains the following:

"Thus perforations may in his view be a specific improvement over recesses or receptacles broadly considered, but recesses broadly considered in combination with the mechanically applied active or absorptive material in a secondary battery is the subject of the claims now under consideration." And again, "As to the improvement in recessed plates, which consisted in carrying the recesses through the plates and forming perforations, Mr. Brush has no separate claim for that specific improvement. Defendants insist that Swan has the prior right to that specific improvement. Brush's claims are for the broad ground of a recess, and it may be that Swan is entitled to be considered the first who carried the recess through the plates, making a recess which was also a perforation. But that question does not arise here."

But it seems that the question does arise. The claim is certainly susceptible of a construction covering a plate containing receptacles not only, but also perforations which go entirely through the plate. In other words, it may be construed to cover the features Mr. Brush is entitled to as well as the one he is not entitled to. So construed, an infringer, after paying complainant for the use of the recesses which belong to Brush, might also be compelled to pay for perforations which, so far as this patent is concerned, belonged to some one else—Eaton, Sellon or Swan. Neither of these gentlemen, if he had a patent for this specific improvement, could prevent complainant from using perforations as distinguished from recesses.

The common meaning of "perforation" is a hole or aperture through a body. It is argued that the patentee intended that this meaning should be adopted, for he says: "Fig. 8 shows a vertical section of a ribbed plate provided with slots or perforations extending through the plate." And yet other parts of the specification would indicate that he intended to make no distinction between perforations and receptacles. As before stated, the language quoted first appeared a year after the original application was filed. The court has grave doubt, therefore, whether these facts do not bring the case within the rule laid down in Railway Co. vs. Sayles, 97 U. S. 563; Kittle vs. Hall, 29 Fed. Rep. 508, 514 and cases cited.

But consideration should be given to the unusual circumstances attending the filings of so large a number of applications and drawings at or about the same time. The inventor seems to have thought that by cross-references the information contained in all could be imported into each separately. This, certainly, bears upon the question of intent. The drawings which he afterwards filed in Case I were in fact filed with Case C, and were in the Patent Office when the application for Case I was filed. The third claim, as originally proposed, covered a ribbed, honey-combed or equivalent plate. If the claims as finally allowed may be fairly construed to cover nothing more than a honey-combed or equivalent plate, which certainly contemplates a plate containing cells or cavities, can it be said that the claims in question have been fatally expanded?

It is true that the ordinarily accepted meaning of the word "perforation" would imply an opening extending entirely through the plate, and such an opening the inventor could not engraft upon the original application. But the word may also have a meaning synonymous with "cavities" or "cells;" it may mean a hole not passing entirely through, but into the centre or interior, and a plate with such perforations the inventor was at liberty, it would seem, to claim under the original application.

Such a construction does not interfere with the rights acquired by the public for it does not permit a broadening of the claim. It holds the inventor strictly to what he asked for in the first instance.

When, by a liberal construction, a patent may be sustained, is it not the duty of the court to adopt it rather than one which, though possibly more plausible, will deprive the patentee of the fruits of a meritorious invention to which he is fairly entitled?

With considerable hesitation I shall hold that these claims, as thus construed, are valid. That they are infringed there can be little doubt. The defendants' electrodes have receptacles; they may be improved receptacles, but they are receptacles nevertheless. These claims do not cover the improvement.

Regarding the pressure claims, so called, the defenses are that they are void for want of invention, and if a construction is placed upon them sufficiently narrow to enable them to stand, the defendants do not infringe.

The tenth claim of 337,298 is as follows:

"10. In the process of making a secondary battery plate or element combining, by means of pressure, an absorptive substance and suitable material to form a support therefor, substantially as set forth."

The only claim of No. 260,654, is as follows:

"The method of forming the plates of a secondary battery, consisting in forming receptacles for oxides of lead in its surface, then applying oxide of lead to the plate and within such receptacles, and afterward subjecting the oxides of lead to pressure."

The latter is a narrower claim than the former, being limited to oxides of lead, to support plates having receptacles and to pressure after, and, therefore, in addition to, the mere mechanical application.

It is not denied that the prior art plainly reveals the use of pressure in making primary battery plates. The distinguishing feature of the invention of these claims is *pressure*. Every other element is covered by other claims. It is argued with plausibility and force that it is not invention for the patentee, with the coated plate before him, to subject it to treatment which he could easily have learned from Leclanché and others.

It is said that the function of pressure is the same whether used on a primary or secondary battery electrode, and that the claim cannot be upheld by importing into it all the valuable features of the broad invention.

It is contended for the complainant, on the other hand, that pressure applied to secondary battery plates produces an entirely different result and performs an entirely different function from that produced when applied to primary battery plates.

If the claims are limited to the use of hydraulic, or other similar pressure, the court, as now advised, would be inclined to recognize the force of the complainant's contention.

But the construction asked for is broad enough to cover the application of the absorptive material with trowel or spatula and the incidental pressure attending this operation.

Says the complainant's expert: "In the plates of defendants' battery I find a series of small cells perfectly filled with an apparently uniform and extremely even mass of absorptive material. I know of no way in which this could have been effectively done except by spreading and forcing into the perforations the absorptive substance, either in the form of a paste or of a powder; generally the application of the absorptive substance to the plate is accomplished by means of a trowel or spatula; the support is usually laid upon a slab of some material such as slate or glass, and the absorptive material in the form of powder or paste, is spread over the plate and forced into the perforations; considerable pressure is always applied to the material to force it into the receptacles; the excess of material is removed by a spatula or some equivalent implement, and the plates are then quite smooth, the absorptive material at the receptacles having almost the thickness of the support plate. From a careful examination of defendant's batteries and from my general knowledge as to the methods employed, I am of the opinion that the absorptive material has been applied in substantially the manner of the tenth claim above described, and that considerable pressure has been employed in the operation."

There can no doubt that a construction as broad as here demanded would invalidate the claim. It would cover a well-known and exceedingly simple operation. It would cover the mechanical application of the coating. It is hard to conceive how it could be made to adhere without some degree of pressure. Even the blotting paper, stick and string of the 1879 electrode would infringe. Pressure such as this, it is believed, was not contemplated by the inventor. He had in view pressure, plus the chemical application, by means of which the coating would adhere more perfectly not only, but by which better conductivity could be obtained.

But if the narrower construction is given these claims, the defendants do not infringe; at least they have not been proved infringers.

I do not lose sight of Mr. Weston's later testimony taken April 3, 1889, but it seems to me that it adds nothing to his former statements upon which the court would be warranted in acting. It is heresay merely and wholly indefinite as to time. The bill was filed in April, 1887, alleging that before the commencement of the action the defendants had infringed. This allegation is hardly sustained by the testimony of a witness taken two years later that he has been informed that the defendants have infringed for "some time."

The stipulation signed by the defendants' solicitors, designed to cover undisputed matters upon the subject of infringement, makes no mention of pressure.

Case C, No. 266,090, contains two classes of claims. The first class (claims 1 to 8 inclusive) relates to the form of the plates; the second class (claims 9, 12 and 14) to the materia) of which the plates are formed.

Claim 7 relates to a secondary battery electrode having its support provided with "cells or cavities;" other claims of the first class relate to "ribs."

Claim 14, in addition to the element of cast lead, has also the element, not elsewhere claimed in this patent, of "slots, perforations or openings."

It is said that the defendants do not infringe the claims of the first class, other than the seventh, for the reason that they do not have a ribbed support plate. The language of the seventh claim described with much greater precision the defendants' supports than that of any other claim of this class. They certainly use cells or cavities. Whether they use ribs or not is, at least, doubtful.

If there were nothing in the art but the contributions of Mr. Brush, it is evident that a narrow construction must be given to these claims. Every word by which even a shade of distinction in the formation of these plates can be expressed, has been adopted. Advantages of the most surprising and mysterious character are said to lurk in the slightest change of size, shape or depth in the holes or recesses. In these circumstances a different rule should be adopted than if the art showed that all these methods of keeping the active material in place are, substantially, equivalents.

The defendants use a support filled with rows of uniform square holes. The Court is not prepared to say that the walls between these holes are ribs. The ordinary meaning of the word would have to be strained and distorted to make it cover "partitions or septs between the cavities," and especially so in an art where a restricted meaning is required. A careful reading of the specification confirms the impression that the patentee intended to use the word, not as now asserted, but in its ordinary sense, as synonymous with projections or ridges. He intended to draw, and does draw, a sharp distinction between plates with ribs and those with cells, cavities and perforations.

Claims 9 and 12 are clearly void for want of patentable novelty. Their only distinguishing feature is cast lead. The complainant, if its position is correctly understood, does not assert that there is anything patentable in casting lead. It is not alleged that the eleventh claim, which covers the process of casting, is infringed. Not only every skilled mechanic, but every schoolboy who has experimented with melted lead, who was shown a model of defendants' grid, and asked to make a series of them, would at once suggest the idea of casting them in molds. This proposition is, virtually, conceded by the complainant's counsel, for, in speaking of the advantages of casting over rolling or pressing, they say: "If this latter were the only advantage and the only mode of operation and result then the invention would be old in any casting of a complex form, and that is the plane on which defendants deal with this invention; but the true understanding of the invention shows that it had its birth in the needs of secondary batteries that operate by expansion and contraction of a permanent coating which must not be allowed to get away from its support, and that its peculiar mode of operation and advantages exist only in such a battery."

What, then, is the novelty upon which these claims are sought to be sustained? It would seem to rest solely on the theory that cast lead produces better results on a secondary battery than rolled or pressed lead. A patent cannot stand for a moment upon ground so narrow. Lead plates were old in secondary batteries, cast lead plates were old in primary batteries. The art of casting was old and free to all. The form of the plates desired would suggest casting them to the skilled artisan. This right being clear, it is idle to assert that one may cast his plates, but shall not be permitted to use them after they are cast. It being quite impossible to pour melted lead into molds without producing cast lead the question arises: Can the person who first uses this obvious process in making secondary battery plates not only obtain a monopoly of the product but of the process as well? Manifestly not! It is not even the substitution of one known material for another. It is the substitution of one well known form for another well known form of the same material.

In Hotchkiss vs. Greenwood, 11 How. 243, the Court says: "The improvement consists in the superiority of material, and which is not new, over that previously employed in making the knob. But this, of itself, can never be the subject of a patent. No one will pretend that a machine, made in whole or in part, of materials better adapted to the purpose for which it is used than the materials of which the old one is constructed, and for that reason better and cheaper, can be distinguished from the old one, or, in the sense of the patent law, can entitle the manufacturer to a patent. The difference is formal, and destitute of ingenuity or invention. It may afford evidence of judgment and skill in the selection and adaptation of the materials in the manufacture of the instrument for the purpose intended, but for nothing more."

See also Bushing Co., vs. Doelger, 23 Blatchf. 167, and cases cited.

With every disposition to act with liberality toward those who, with undoubted genius and untiring research, are developing this recently-discovered mine of industry, the Court cannot ignore the repeated and uniform utterances of the Supreme Court upon this subject:

In addition to the familiar and oft quoted authorities, see the following decided at the present term:

Burt vs. Evory, Feb. 3, 1890; Hill vs. Wooster, Jan. 13, 1890; Day vs Railway Co, 132 U. S. 98; Watson vs. Railway Co., Id. 161; Marchand vs Emken, Id. 195; Royer vs. Roth, Id. 201.

Claim 14 may be construed as covering a combination, one element of which, the slots, etc., is new and useful, and is not covered by the other claims. The original specification and drawings, filed June 9, 1881, describe and show grooved, honey-combed and slotted plates. Indeed, the drawings, for the absence of which Case I is criticized, were filed at the outset in case C.

Of Fig. 4, showing the slotted plate, the specification say:

"Here the supporting plate between the ribs is removed, the latter being supported by the heavier side or end ribs and other intermediate transverse ribs if necessary. This modification is in form somewhat like an ordinary window blind with the slats open."

This can mean nothing else except that there were openings extending entirely through the plate. The specification as originally filed is sufficient, therefore, to support the claim.

Regarding the infringement of this claim and claim 7 there can be no doubt, and the same is true of the claims in controversy of Case I.

The point is suggested that the defendant Bracken is not proved to be an infringer, but the stipulation signed by the solicitors makes no distinction between the defendants.

The questions arising on the expiration of the Italian patent are of a serious character, and, in view of the elaborate attention given to the other defenses, would seem to demand greater consideration in the testimony and in the briefs. The patent appears in the record, but no word of explanation, so far as can be discovered, has been offered on the part of the defendants. The only testimony explanatory of the patent is the clear and positive statement of the complainant's expert, that it describes and claims inventions entirely different from those of the patents in controversy.

The patent contains five divisions and twenty-two claims. It requires little expert knowledge to perceive that some of these are wholly dissimilar to the inventions in suit. Others would seem to be dangerously near to some of the inventions, but those portions of the Italian patent, which seems to the Court to be most in point are but little discussed, and in some instances are not even alluded to in the defendants' brief.

For example, take a portion of Division D and its corresponding claims. The Italian patent says:

"To form an element having a core or body coated with the mass described, I take a sheet or other suitable piece of lead, or of other substance suitable for the purpose, and if necessary roughen or score its surface, or pierce it with numerous perforations to insure a firm adhesion of the mass which is to constitute the active coating. I cover it with the finely divided superficially oxidized lead (or the mixture of metallic lead and lead oxide particles) and apply heavy pressure. The result is that the finely divided particles are not only pressed into a firm and strongly coherent mass, but the mass is also firmly united to the supporting core or body. This core may be of lead, or it may consist of non-oxidizable metal, such as gold or platinum, or any alloy of these metals with lead."

Claim 17 of the Italian patent is as follows:

"A process for making secondary battery elements (or material from which said elements can be constructed); said process consisting in covering one, or more, or all of the surfaces of a suitable metallic and electro-conducting core or body, either with superficially oxidized particles of lead, or with a mixture of particles of pure lead and lead oxide, and, afterward, applying pressure sufficient both to unite said particles or mixture into a compact and firmly coherent mass, and to unite the mass to the core of body, as set forth in 'Division D.'"

Bearing in mind the fact that metallic lead and lead oxide are absorptive or active material, a comparison with some of the claims in controversy will certainly show marked features of similarity.

Claim 10 of Case I is as follows:

"In the process of making a secondary battery plate or element, combining by means of pressure an absorptive substance and suitable material to form a support therefor, substantially as set forth."

To the uninitiated it would seem that these claims are for similar inventions. Would not a person, following the formula of the Italian patent, infringe the pressure claims of the patent in suit? Is not the method of making electrodes by pressing active material upon the support set free "by the expiration of the Italian patent?"

It is also true that Division D of the Italian patent describes also the process of uniting the absorptive substance into a compact or firmly adherent body or mass without the intervention of a support plate, but to the ordinary reader it would seem to be reasonably clear that when the inventor says, as in the description quoted, that he takes a sheet of lead, pierces it with numerous perforations to insure a firm adhesion of the mass which is to constitute the active coating, covers the support with the mixture of metallic lead and applies heavy pressure, so that the mass is not only pressed together but is also firmly united to the supporting core, he is describing the process which is covered by the claim in question.

Other claims of the Italian patent are as follows:

"11. As a new article of manufacture, a mass consisting of a mechanical mixture or association of metallic lead and oxide of lead, united by pressure into a coherent and firm body, substantially as set forth in 'Division D.'"

"14. For use in an element of a secondary battery, a metallic core, or body, to one or more sides of which is attached a mass or substance, primarily consisting of metallic lead and oxide of lead, united by pressure so as to be strong and firmly coherent, substantially as set forth in 'Division D.'"

"15. A secondary battery element, consisting of a metallic core, or body having attached to it a coating primarily consisting of mixed lead and oxide of lead, firmly united by pressure into a strong and coherent mass, substantially as set forth in 'Division D.'"

"16. A secondary battery element, consisting of the combination with a metallic supporting core or body of a coating attached or united to said core; said coating primarily consisting of metallic lead and lead oxide in an intimately commingled state, united by pressure into a strong and firmly coherent mass, substantially as set forth in 'Division D.'"

It will be observed that the first of these, Claim 11, covers only lead and oxide of lead mixed and united by pressure into a coherent mass for use as an electrode or as a coating. The element of a support plate is wanting in this claim, but it is present, under the name of "a metallic core or body," in all the others.

Compare these claims with the pressure claims of the patents in suit, but also compare them—and particularly claim 11—with claims 12 and 13 of Case I. They are as follows:

"12. Absorptive material for use in secondary batteries formed into a coherent mass by pressure, substantially as set forth."

"13. For use in secondary batteries, porous, granular, spongy, or equivalent lead formed into a coherent mass by pressure, substantially as set forth."

The language is different, but in substance, where is the lack of identity?

But all these are questions which the Court, in view of the action of the American and Italian patent officials, in distinguishing between the inventions covered by the Italian patent and those covered by the patent in suit, and in view of the uncontradicted opinion of the complainant's expert, should hesitate long before answering in the affirmative.

Mr. Weston says of "Division D" of the Italian patent:

"It is for an improved form of electrode especially adapted to the foundation by electrical disintegration, either by the Planté method, or by the peculiar method of electrical disintegration invented by Mr. Brush and described in Division A."

It should be remembered that we are dealing here with a mysterious and occult power of nature, the science of which is still in its infancy, the phenomena of which are but little understood, even by those who have made its study their life work. For one who has but a casual and superficial knowledge to place a construction upon a patent, which is addressed to those who are educated in this department of science, and which constantly employs terms of art, in opposition to the opinion of the only electrician who speaks upon the subject, would be unwarranted, especially when such a construction will destroy rights and interests of great value. In very many of the patent causes which come before the courts, where the device is so simple that any man of ordinary capacity can understand it, the presence of an expert is wholly unnecessary, but when the invention relates to a subject where even the pioneers are still groping in shadows, the court needs the instruction of those most competent to advise, and without such assistance should proceed with the utmost caution. The law does not favor forfeitures. A patent should never be declared invalid because of the expiration of a foreign patent, if there is doubt about the inventions being the same. The burden is upon the defendants and the doubt should be resolved in favor of the patent.

After such study as I have been able to give the subject, I am not satisfied that the Italian patent is for the same invention as those in controversy. It is sufficient, for present purposes, to state that the mind of the court is in doubt upon the question.

The language of Judge Bradley in the case of Bishof vs Wethered, 9 Wall, 812, where a patent was introduced, as here, without explanation, seems particularly applicable.

"The specifications of patents for inventions are documents of a peculiar kind. They profess to describe mechanisms and complicated machinery, chemical compositions and other manufactured products, which have their existence *in pais*, outside of the documents themselves; and which are commonly described by terms of the art or mystery to which they respectively belong; and these

descriptions and terms of art often require peculiar knowledge and education to understand them aright; and slight verbal variations, scarcely noticeable to a common reader, would be detected by an expert in the art, indicating an important variation in the invention. Indeed, the whole subject matter of a patent is an embodied conception outside of the patent itself, which, to the mind of those expert in the art, stands out in clear and distinct relief, while it is often unperceived, or but dimly perceived by the uninitiated. This outward embodiment of the terms contained in the patent is the thing invented, and is to be properly sought, like the explanation of all latent ambiguities arising from the description of external things, by evidence *in pais*." It was, therefore, decided that the Circuit Court was right in charging the jury that there was not on the face of the respective patents such an identity as authorized the Court to pronounce that they were for one and the same invention.

No. 260,654 is not, in any event, affected by the Italian patent. The former bears date July 4, 1882, the latter Aug. 8, 1882, and it was not applied for till July 28, 1882.

It follows that upon filing a disclaimer of the invalid claims the complainant is entitled to a decree in accordance with this opinion, but without costs.

In connection with this decision the following statemcnt should, I think, be made:

A suit similar to this is pending against the Electrical Accumulator Company. Sometime after the oral argument in this cause was concluded, the counsel for that company, after due motion to all parties interested, called the attention of the Court to the following facts:

On the 28th of March, ten days after the decision on the Faure patent was filed, the president and secretary of the Julien Company, without the knowledge or consent of counsel, obtained from the complainant an option to take an exclusive license under the patents in suit provided they were sustained.

In view of these facts the Court was asked either to refuse to decide the cause altogether or to postpone the decision until the cause against the Accumulator Company is ready for argument.

The Court urged upon counsel the importance of having the issues passed upon in a controversy which is, in all respects, genuine and earnest, and expressed his own disinclination to decide an action where a suspicion to the contrary might exist. Several plans were suggested, but none upon which counsel could agree. As a decision in the other cause will not be reached for a year, and as the option alluded to is not regarded as a settlement of the cause, the conclusion has been reached that justice to the parties demands that a decision should be made at this time.

I regret having to inflict so long an opinion upon litigants and counsel, but the examination and study of a record and briefs aggregating twenty-five hundred printed pages, has made it impossible to devote the necessary time to review and condensation.

Board of Electrical Control.

The fight for the Standard Company is a stubborn one, and, although it seemed virtually over when the Board of Electrical Control met on the 22d inst., it is evident from what ensued that the struggle against the big Westinghouse deal will be maintained up to the last. The meeting was called for 10:30, but the commissioners did not take their seats until after eleven, as a copy of the order dissolving the injunction by which the Manhattan Company restrained the Board from entering into a contract with the Standard Company could not be obtained. It appeared that the order which was made the previous day by Judge Andrews in the Supreme Court had not been recorded, and the consequent delay was unfortunate for those who expected to close the contract forthwith. In the meantime Elihu Root and Delancey Nicoll were busy in the Supreme Court. When the settlement of the order on the decision of the 21st was brought before Judge Andrews, they informed the court that an appeal had been taken, and applied for a stay to prevent any action being taken by the Board of Electrical Control toward completing the proposed arrangement for the construction of subways until the appeal could be heard and decided. Judge Andrews stated that the arguments in the case would be heard next week at a special court, and as he had no doubt a decision would shortly be reached, he granted the stay of proceedings.

The result of this application was immediately conveyed to the Board of Electrical Control by Mr. Dean, the Assistant District Attorney, and Mayor Grant said that as the Board could do nothing it might as well adjourn.

Here Mr. Clark, of Coot & Clark, the legal representatives of the Harlem Electric Lighting Company, rose and said that although the company for which he appeared had carefully obeyed the behests of the Board, it found its business impeded by the impossibility of getting into the subways.

The Mayor said the matter would be submitted to the engineer. Mr. Clark insisted that the delay was an unjust and injurious one, and that his clients had deserved more impartial treatment at the hands of the Board. The Mayor stated that the meeting then in progress was a special one and was not open to discuss general business. Senator Grady said the East River Company had the same complaint to make, and he protested against certain companies being "frozen out" by the strong political influence which appeared to be working against them. Judge Kelly intimated that a similar application had been made months before, but no satisfaction had been got from the Board.

The Mayor ended the argument by moving the adjournment of the Board, which will meet again on the 26th.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, March 16, 1890.

The Wing Manufacturing Company, formerly of Cliff street, has opened offices at 80 John street, where they exhibit the Wing fans and ventilators.

In the National Fast Telegraphing Tournament the entries, which closed March 19, sum up as follows: Class A, 12; Class B, 24; Old Timers, 5; Ladies, 15.

Big Consolidation.—The combination, electrolier and gas fixture business of the Archer & Pancoast Manufacturing Company, 898 and 900 Broadway, having a large factory at Thirty-third street and First avenue, and Oxley, Giddings & Enos, 224-232 Canal street, who last year completed in Brooklyn one of the finest factory buildings in this section, have consolidated.

W. T. Goodnow, general manager of the Lebanon Electric Light and Ice Company, Lebanon, Ky., was in town the past week looking up additions to his plant. Mr. Goodnow is running a Thomson-Houston 650-light incandescent dynamo and a 30-light arc machine, and supplying the city with the full complement of lamps of the two. The excess of power is being used in the manufacture of ice by a special process.

The Clark Electric Company, 192 Broadway, manufacturers of the Clark Arc Light system, have one of their lamps running on the Loomis incandescent electric light system, 18 Broadway. They claim that it is a successful arc lamp for low-tension circuits, giving a steady light and using 50 volts and eight ampères, with resistance reducing the current from 110 volts. The Loomis system is manufactured and sold by the Eureka Electric Company, 18 Broadway.

Mr. T. McCoubray, whose abilities in selling and handling motors are well known, has thrown in his lot with the popular firm of the Crocker & Wheeler Motor Co., 322 Seventh avenue, and will look after the sales department of their motors for arc and incandescent circuits. The arc motor has been fully described in our columns, but I think a short reference will not be out of place. The arc motors are very effective in operation, as the speed is perfectly controlled under varying loads by the current drawing the armature in and out of the field in accordance with the variation in the power required.

Mr. W. S. Horry, designer of the Horry alternating dynamo exhibited at the factory of the Wellington Manufacturing Company, 468 Cherry street, has one of his machines running thirty-three 32 c. p. 50 volt Sawyer-Man lamps. The capacity of the machine is two hundred and fifty 20 c. p. 50 volt lamps, at a speed of 1,800 revolutions. This dynamo was invented and patented in England in 1882, and in this country in 1884, the machine being different in design from any on the market. Mr. Horry claims for the machine extreme simplicity, high efficiency and large output for the size of the dynamo, the present generator weighing 600 pounds.

Indurated Fibre Ware is now made in so many different shapes that it strikes almost every branch of the business.

In the electrical line the Sprague Electric Railway and Motor Company have lately placed an order for switch covers. The points that these will not shrink or swell, and also that they will be waterproof, lead to the adoption of this material.

In the line of fire buckets, fire extinguishers and other fire apparatus these goods are satisfactory, and for office use, umbrella stands, spittoons and water coolers of this ware are now handled by the trade.

The general agents for the manufacturers, Cordley & Hayes, are located at 173 and 175 Duane street.

Vulcabeston, manufactured by the H. W. Johns Manufacturing Company, 87 Maiden Lane, has, after thorough tests by the leading electric light and motor companies, created an almost unlimited demand for itself; and, to meet the increasing orders, the company is enlarging its factory at Hartford, Conn., to double its present capacity. The reasons for this popularity are that, while vulcabeston is composed of asbestos, rubber, etc.' and vulcanized for all electrical applications where a high resistance material is needed, it also combines tensile strength, flexibility, fire and water-proof qualities and resistance to acids. Among a few recent orders are magnet-sleeves and flange heads by the thousand, as well as commutator heads and sections, brush-holders, switch-bases, battery cells, washers, and numerous other minor parts of electrical instruments and apparatus.

The Aluminum Brass and Bronze Company, 53 Chambers street, Stewart Building, T. C. Fowler, manager, and S. B. Hawley and F. G. Stone, associates, has on exhibition a handsome brass and aluminum cast gong for electrical uses. The tone is alike rich, soft and penetrating, showing the qualifications necessary for electric bells. Many other specimens of Cowles alloys are shown in wrought and cast aluminum, the points of advantage of this material being that it weighs much less than copper of the same degree of circumference, and has a much greater tensile strength than copper of equal conductivity. For parts of instruments where brass is generally used it is said to be superior. Other productions of this firm are the Cowles alloys, sheet copper, copper wire, commutator bars, sheet brass and silicon bronze wire, which is so generally used for trolley wires by the principal electric railways.

Keuffel & Esser, extensive manufacturers and importers of electricians' drawing instruments and materials, have recently enlarged their salesrooms, where they exhibit a full line of such goods. A specialty is intricate appliances for devising and measuring expert electrical apparatus. They recently devised a large protractor for the Weston Electrical Instrument Company, and they make and carry in stock their improved protractor, which embodies several valuable improvements over the ordinary styles, its convenience for laying out scales at any degree, being very marked. Half-circle protractors, with and without arms, are also made of the best German silver. Various styles of planimeters are made to order and carried in stock. Their drawing instruments are of infinite variety. Their drawing and upright tables are favorites, and helios and E. T. papers are extremely popular for blue printing.

E. T. Copeland, selling agent for the New York Safety Steam Power Company's full line of upright and horizontal engines for electric lighting service, designed for high speed, high pressure and hard work, has installed thousands of horse power for electric light service. Among a few of his latest orders are the Augusta Railway Company of Augusta, Ga., which is installing an electric railroad system to displace horses, and has ordered one 200 h. p. automatic high-speed engine. This plant is under the supervision of Wm. B. Knight, chief engineer, of Kansas City. The Coates House, Kansas City, the largest hotel in the Southwest, will install a large electric light plant, and have ordered one 65 h. p. and one 150 h. p. New York safety automatic high-speed engines. One concern has ordered 17 of their upright engines, and another 18 of the same. A 100 h. p. automatic has just been shipped to Japan. They have an order for five 60 h. p. automatic electric light engines from the Bridgeport Copper Company. Mr. Copeland has the order for the engines for the new New York *World* building, comprising two 100 h. p. engines for the Western Electric Company's system of incandescent lighting.

Mr. George H. Meeker has been selected to assist Mr. J. W Godfrey, of the New York Insulated Wire Company, 649 to 651 Broadway. Mr. Godfrey has met with such universal success in the introduction of this Company's wires, cables and other specialties, and the territory has grown to such large proportions, that it has become necessary for the Company, and the welfare of Mr. Godfrey, to appoint an assistant. I wish Mr. Meeker every success upon his trip, and a safe and pleasant journey. Additions have been made to the factory in order to fill the large orders and to give greater attention to special sizes of wires and cables. The Knapp Electrical Works, at 54 and 56 Franklin street, Chicago, are agents for the New York Insulated Wire Company's goods and specialties in the west, and are selling large quantities right along. A full car load of wires, cables, tapes, etc., has just been shipped them. The Fisher Electrical Company, of Detroit, Mich., were recently appointed agents for that vicinity, and carry a full line of their manufactures. One hundred miles of their noted competition line wire of No. 6 guage has been shipped to Detroit this past week; $4,000 worth of various sizes of wire and cables and were recently purchased for the Brush Electric Company's large plant in Yokahoma, Japan.

W. T. H.

WESTERN NOTES.

Branch Office of The Electrical World,
465 Rookery, Chicago, March 15, 1890.

Mr. H. P. Lucas, representing Holmes, Booth & Haydens, of New York, is in the city *en route* west to capture a big order.

Mr. S. M. Wheeler, Middletown, Conn., is now in charge of the construction of a large Schuyler plant in course of erection in Chicago.

The Saginaw, Mich., Union Street Railway Company has purchased the Bristol Street bridge, and will now extend the service to the West side.

Mr. J. M. Denniston, the city representative of the Westinghouse interests, has been quite successful in closing certain contracts for isolated lighting.

Mr. Franklin G. Beach, superintendent of the Central Union Telephone Company, Chicago, is again at his office after a second siege of incipient pneumonia.

The Western Engineering Company, of Kansas City, Mo., has been duly incorporated with a capital stock of $2,000, by H. M. Holden, E. B. Kay and C. W. Hastings.

The Central Electric Company, Chicago, have just received quite a large order for supplies from Schidzuoka, Japan, which speaks well for the distance to which their trade is extending.

Mr. George A. McKinlock, treasurer of the Central Electric Company, Chicago, is making an extended trip through the West and along the Pacific coast, and reports excellent business prospects.

The Edison Illuminating Company, of Detroit, are closing contracts for the erection of a second large station in the resident portion of the city, with a capacity of 3,000 incandescent lights.

The Denver Consolidated Electric Company have secured the contract for the public lighting at $150 per year per arc light of 2,000 candle power, burning from sunset to sunrise, 365 nights.

Mr. J. J. Nate, the well known purchasing agent of the Chicago Telephone Company, has returned from his extended trip through the South and Southwest, where he went to regain his health.

Mr. William Hibbard, of Elgin telephone fame, is opening up a branch office at 103 Adams Street, Chicago, and will enter more fully into the construction of acoustic telephone lines, and work of a similar character.

Mr. S. P Wells, Jr., formerly superintendent of the Western Division of the North American Construction Company, Pittsburgh, with headquarters in Chicago, has been transferred to the Westinghouse offices in Cincinnati.

The Fairbault, Minn., Consolidated Gas and Electric Company lost a 650-light incandescent dynamo, a 125-h. p. engine and some supplies, by reason of a fire that started in the boiler room of their new station last Saturday.

Shay, Stephens & Co., Chicago, are supplying the trade with a glass insulator of special form, designed to replace the porcelain insulator ordinarily used in certain classes of work, especially where there is more or less dampness.

Electric Street Cars for Burlington, Ia.—Manager Jones, of the Union Street Railway Company, of Burlington, states that the contracts for changing the horse cars into an electric system have been let, and work will begin at once.

Sensible City Fathers.—The wisdom and business sagacity of the committee appointed by the City Council of Denver, Colo., was clearly shown when they reported adversely regarding the advisability of the city owning its own electric lighting plant, and recommended that a contract be made with one of the local companies.

The Sperry Electric Company, Chicago, report that the suit of the Brush Electric Light Company against the Belvidere Electric Light Company, mentioned in the issue of the Electrical World of March 8, does not appertain to the Sperry Electric Company of Chicago, nor apply to any apparatus manufactured by them, either at present or in the past.

Rice & Whitacre, Chicago, are now nicely situated in their new and extensive quarters, Nos. 47 and 49 South Canal street, and are better prepared than ever for handling contracts covering the complete installation of steam plants of the largest character. Among the late contracts finished by this house are complete steam plants erected in Cuba, in Vera Cruz, Mexico, and in far away Tasmania.

Mr. George A. Mayo, Manager of the Rockford Electric Manufacturing Company, Rockford, Ill., called on several of his friends in Chicago on Wednesday last. Referring to business, Mr. Mayo said: "We are constantly adding to our force and are running until ten o'clock every night. The number of orders received has far exceeded our most sanguine expectations, and the prospects are unusually bright."

Mr. Fred. E. Degenhardt, Chicago, has been elected commander of the Electric Conclave of the Royal Adelphia, a benevolent society organized to provide for its members in case of accident, sickness or death. The benefits to be derived from the order are a payment of $15 per week in case of sickness or accident, $1,000 for loss of a limb, and $1,500 in case of total disability. The conclave is composed of gentlemen from the various electrical industries.

The Storage Battery Motor Company, Chicago, have arranged to place one of their special cars on the line running from Dearborn station over the Dearborn street bridge to the Northwestern depot. As this car will run through the heart of the city and for some distance on the tracks of the cable line, a better proof of the deep interest taken by Mr. Charles T. Yerkes in all matters of this character, as well as his faith in the ultimate commercial success of the storage battery, can hardly be desired.

The Electrical Supply Company, Chicago, are very busy in both their departments, that of light electric currents as well as in the department of heavy electric currents. The latter department is presided over by Mr. William Taylor, who is taking care of all the orders coming in for their Habirshaw rubber-covered wire, which is now carried in stock in such large quantities that an order of almost any size can be quickly filled, which will be good news to all contractors who prefer to use an insulation like the Habirshaw.

Lexington Street Railroad Sold.—T. H. Doughty, representing New York City capitalists, has been here two weeks negotiating for the Lexington street railway, consisting of 10 miles of road. The Belt Line Company has also been a bidder, but this afternoon Mr. J. P. Metcalfe, late owner of the road, says he sold it to Doughty for between $45,000 and $50,000, he refusing to state the exact price. Doughty says the sale is not consummated, and that he will not know until he hears from his employers. The new company intends substituting electricity for the mules now being used. It will require an act of the Legislature to enable the company to do this.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$290@$295	Cumberland	$ 59@ $60
Central Union	58@ 59	Wisconsin	116@ 117
Michigan	96@ 98	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	23@ 25
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$93@$94	Chicago Edison Co	$112@$113

Mr. A. J. Mayer, of the Royal Silk Manufacturing Company, New York, has been in town this week arranging with one of the large supply houses to handle the silk non-combustible towels made by this company for wiping dynamos, motors and other machinery. Long since, the insurance authorities said that if every manufacturer would abandon the use of cotton waste, with all its attendant dangers, it would materially reduce the risk, and the assured would consequently secure a greater immunity from fire, less interruption of business and—best of all—decreased cost of in-

surance. These silk towels are intended to accomplish the above results.

The Charles Munson Belting Company, Chicago, have already delivered to G. Lohse & Co., of the City of Mexico, Mexico, a first shipment of Munson leather belting amounting in value to over $10,000, to be followed by shipments to other Mexican points, and naturally feel elated over having secured this excellent trade. At the beginning of the year they anticipated a heavy increase in business before the summer was over, and thus secured two double floors adjoining their factory, being content to pay the rent for same for a year in order to secure the location. The wisdom of this was quickly shown when the unprecedented spring trade now enjoyed opened and the orders came pouring in, rendering necessary the immediate occupancy of the above mentioned floors and the erection of six heavy hydraulic presses, as well as an increase in the number of their workmen, although they now employ over sixty hands.

The Burton Heater Practically Adopted.—The Burton Electric Company has received a second order from the St. Louis and East St. Louis Electric Railway Company for electric heaters for their new cars now being constructed by the St. Louis Car Company. The heaters will be sent direct to the car works and the new cars turned out fully equipped. The Marlborough, Mass., and the Binghamton, N. Y., electric roads also ordered a full equipment of heaters for their cars, in both cases, after a thorough test of them. Heaters have been sent to Scranton and Wilkesbarre, Pa., for trial, and there is reason to believe that these roads will adopt them. In addition to these good reports of the heater, the agents of the Burton Company, in Philadelphia, are preparing for an exhibition of it at the Master Builders' Association in that city. This will no doubt lead to their future adoption.

Theatre Lighting.—Mr. F. H. Soden, of the Chicago office of the Thomson-Houston Electric Company, has installed a novel arrangement for securing an abundance of soft light in Jacob's North Side Opera House, with perfect ventilation. The device takes the place of the conventional gas burner commonly used in gas lighted theatres, and is in form similar to a large parasol 18 feet in diameter, the perforations in the cover permitting the egress of the vitiated atmosphere. The rod and handle are so formed as to permit the use of gas jets should occasion require; while from the tip of each rib incandescent bulbs depend, all forming a perfect and powerful circle of light, the rays from which are reflected throughout the large hall, giving a beautiful impression when seen from below. Another feature that proves very attractive is the use of incandescent bulbs arranged in a wire net to indicate the name of the company then playing, as, for instance, "Booth." Formerly gas jets were used to form the words, but the incandescent lamp proves far more attractive, besides affording more light.

Mr. H. B. Cragin, the Chicago agent of the Washburn & Moen Manufacturing Company, of Worcester, Mass., presided at the banquet tendered last evening at the Palmer by that company to their Chicago employés, seventy-five of whom were present. Music was furnished by the Tomasso Mandolin Quartet, solos were rendered by Mr. George L. Whyte, and Mr. Lorado Taft gave an amusing illustration of the sculptor's art. Mr. Cragin delivered the address of welcome, and the following toasts were responded to: "Our Company," Herbert S. Smith; "The Factory Office and Home," E. C. Lott; "Trials of a Traveler," H. T. Pratt; "Success in Business Life," C. T. Boynton; "True as Steel," C. C. Cragin; "Business Friendships," Leonard Larkin; "Our Storekeepers," H. H. Drake. It is probably unnecessary to state that it is just these little attentions that build up a friendship between employer and employé, that tend to make the latter loyal to his company's interests at all times, and to continually strive with renewed effort to advance the prosperity of the business; to be polite, attentive and forgetful of self interests, knowing that promotion will as surely come to the faithful business man as that the sun will rise on the morrow.

The National Association of Fire Engineers will hold their next annual meeting at Detroit, beginning Aug. 19, when papers on the following topics of interest to the electrical fraternity will be presented, as well as many others: "Use and storage of crude petroleum. Can it be used with safety? What character of buildings for storage? Also, what distance from other buildings to be considered safe?"—Chief W. W. Seay, Rome, Ga. "Construction of fire alarm telegraph in municipalities."—Brown Flanders, superintendent of fire alarms, Boston. "Fire departments and electric light companies should work in harmony for mutual interest. How can this be best brought about?"—Mr. C. C. Haskins, of Chicago. "What is necessary in the construction of electric lighting and power wires generally for the safe handling by firemen?"—Elwood V. Matlock, supervisor of electric lighting, St. Louis. "Should local legislation be vested in the chief engineers of fire departments, in conjunction with the other executive officers? If so, how far, and what authority should they have with regard to the control and manner in which all overhead electric wires are hung and operated?"—T. K. Harding, Bay City, Mich. "The feasibility of using electric lights at fires to facilitate the work at night."—Prof. Barrett, of Chicago.

The Detroit Electrical Works.—The northward growth of the city is strongly indicated by the move of the Detroit Electrical works, just decided upon. The building at the corner of Woodbridge and Seventh streets having been taken by the new Union Depot Company, the directors have had their eyes open for some time for an available site for a new building. After a thorough canvas they selected as the most available site a piece of ground at the railroad crossing, on the west side of Woodward avenue. The site fronts on Woodward avenue and extends from the railroad to Baltimore avenue. This they have purchased, and will begin at once the erection of a commodious and handsome structure—one that will be an ornament and an attraction to that locality, and contribute materially to the development of that part of the city. The Detroit Electrical Works, as is generally known, is one of the most extensive of the kind in the country and has among its stockholders and directors some of the wealthy and enterprising citizens of Detroit, whose names are a guarantee that the company will fulfill all its promises. The works now employ over 200 persons, but with the increased facilities which the new building will give them, they will be able to employ to advantage about 600. Not the least significant fact in connection with this new move is the statement that the works will be devoted largely to the manufacture of equipments for electric railways. The works are now engaged on several contracts of this nature, the largest of which is that for the equipment of 20 miles of railway for the Saginaws, which will be completed by July 1.

Recent Thomson-Houston Contracts.—The Citizens' Street Railway Company, of Indianapolis, Ind., six and a half miles of equipment, and 10 motor cars. Pueblo, Col., the Pueblo City Railway, 10 motor cars. The overhead construction will be used throughout on this line, which comprises a total of 21 miles of track. Port Townsend, Wash., the Port Townsend Street Railway Company, three cars. The line is three miles in length; overhead construction will be used. The Rockford Street Railway Company, a line (overhead construction) of six and three quarters miles in length, and an equipment of seven motor cars. The South Bend & Mishawaka Street Railway Co., an electric railway at SouthBend, Ind. The line will be eight miles in length (overhead construction), and six motor cars will be used. Springfield City Railway Company, Springfield, Mass., a line of two miles in length, on which six cars will be operated. The Springfield City Railway Company, Springfield, Ill., eight motor cars and seven miles of track, overhead system. Toledo Electric Railway Company, Toledo, O., an additional equipment of 17 miles of track and 25 motor cars. There are already three motor cars in operation here, and two miles and one half of track have been equipped; with the additions the road will have 28 motor cars and 19½ miles electrically operated. The Winona City Street Railway Company, Winona, Minn., five motor cars and four miles of track, and the Douglas County Street Railway Company, the same length of track and two motor cars. Shreveport, La., four motor cars and four miles of track. These contracts aggregate 114 motor cars and 107.05 miles of track. F. DE L.

THE ELECTRIC LIGHT.

Canton, Mass., will have an electric light plant in the near future. The Westinghouse Electric Company is engaged in installing alternating current apparatus for a 750 light plant.

The Big Stone Gap Improvement Company, of Big Stone Gap, Va., has just ordered a plant of 50 arc and 750 incandescent lights from the Thomson-Houston Company, and will put its plant in operation about May 1.

Methuen, Mass.—The Westinghouse Electric Company has been awarded the contract to furnish an alternating current central station plant with its apparatus. The station will have a capacity of 750 incandescent and 45 arc lights.

The bill now pending in the legislature allowing towns and fire districts to establish electric light plants of their own, may produce some immediate effect. There is considerable agitation over it in the South Adams fire district, and it is not at all unlikely that the district will take the electric lighting within its limits into its own hands.

Bluff Point.—The annual visitors to Bluff Point, N. Y., may prepare themselves for a surprise this summer, because this fashionable resort will have a central station alternating current electric light plant. The Westinghouse Company, of Pittsburgh, Pa., was awarded the contract for the furnishing of the machinery of the plant, which is to have a capacity of 1,500 lights.

The Westinghouse Electric Company has been awarded the contract of furnishing alternate current apparatus to increase the capacity of the lighting plant of the Nashville Lighting and Power Company to the extent of 3,000 incandescent lights. Twenty-eight hundred lights capacity of Westinghouse apparatus is already in use by this company. In addition to the order for incandescent machinery the Nashville company has placed with the Westinghouse Electric Company one for 540 arc lights.

The Central High School, of Pittsburgh, Pa., has been presented with a 500-light electric plant. Some days since the Westinghouse Electric Company quietly made the proffer of the plant to the Central Board of Education and this body immediately took the matter under consideration. A decision was speedily arrived at and to-day the company received a formal acceptance of the gift, with a vote of thanks from the Board. The Westinghouse Company gives the High School a 500-light dynamo. Two hundred incandescent lights are sufficient to light the school, with plenty to spare, and the operation of the plant will cost much less than the price paid for the present illumination.

The Westinghouse Alternating Current Arc Light System, the special features of which are that it is used in connection with a single flat carbon lamp, is now being introduced in the city of Pittsburgh. Last Sunday night about sixty of the lamps were operated in the east end of the city, and a number of prominent men and the representatives of the local papers were invited to witness the innovation in street lighting.

In speaking about the matter the next day, one of the Pittsburgh papers said:

"The new system of arc lighting of the Westinghouse Electric Company was successfully tested in the East End last night. In this system but one carbon is required to each lamp, which lasts 42 hours. The light from these lamps is 20 per cent. brighter than that from the old lamps and much steadier. The machines can be manufactured to generate electricity for 250 arc lights, thus affording a great deal of economy of space. The system is also claimed to be perfectly safe, because it is operated with the converter, which reduces the voltage of the current to such an extent as to render any accidental shock perfectly harmless."

APPLICATIONS OF POWER.

In Germany a contract has been closed by the Thomson-Houston International Company with the Bremen Tramway Company for six motor cars and two miles of electrical equipment.

To Run Cars by Electricity.—The Jersey City and Bergen Horse Car Railroad Company has decided to run all its cars by electricity, and a contract has already been drawn between the company and the Jersey City Electric Light Company, which is to supply the power.

The Texas Street Railway and Land Company has organized in Boston, Mass., for the purpose of buying and operating street railways in Texas cities. The capital stock is $200,000, and their bonded indebtedness $250,000. The stock and bonds have all been subscribed for. The Boston directors are well known bankers. The Chicago directors are the Hon. Abner Taylor and Franklin H. Watruss, and W. M. D. Lee, of Leavenworth, Kas., who is president of the Brazos company, and Thomas J. Harley, of Fort Worth.

Electric Propulsion for Several Street Railways.—The Philadelphia syndicate which has been buying street railways in Northern New Jersey has, it is reported, secured control of the Newark and Elizabeth line and the Orange Crosstown line. This makes the syndicate owners of street car lines in Montclair, East Orange, Irvington, South Orange, Belleville, Orange, Bloomfield and Newark. The new "Rapid Transit" road now building in Newark will use the overhead electric wire system for motive power. Though it is not known whether the Philadelphia syndicate intends to secure control of this new line, they contemplate using the same system for motive power on the lines they now control.

Mining Machinery.—The old-fashioned way of mining coa with the pick and shovel is rapidly becoming a thing of the past in the Monongahela coal region. The mining machine is constantly making headway, and it will not be very long until it will have entirely superseded the old method. With the introduction of these machines, however, electricity is also receiving a great boom, because demonstrations have proved beyond a doubt that it is the most suitable motive power for the machines. In the Monongahela Valley the Hercules mining machine has gained extraordinary popularity with the coal operators, and the time is not far distant when there will not be a single mine without one of these machines. In connection with the Hercules mining machine the Tesla alternating current motor is operated. A few months ago the first Hercules machine and Tesla motor were introduced in the first pool of the Monongahela coalfield. Since then, however, the orders for the machine have greatly increased. The last mine in which electric power is utilized for the production of coal is the Armstrong mine. The contract for a perfect equipment was concluded only a few days ago and the installation of the machinery will take place within a very short time.

The Cost of Electric Traction.—The figure of 4½d.—nine cents—per car-mile at which the Electric Traction Company states its readiness to work the entire system of the North Metropolitan Tramways Company by accumulator cars, has not unnaturally been thought in some quarters to be only sufficient to pay out-of-pocket expenses, and considerable scepticism exists as to its capability of making accumulator traction profitable at such a figure even under the most favorable circumstances. The text upon which the sceptics preach are some figures recently published by M. Michelet with regard to the Julien cars at Brussels. Careful bookkeeping showed that 1½d. per car mile for accumulator renewals, and 1d. per car mile for motor and gearing renewals, had to be allowed. Considering, however, that the cost of accumulator plates in Brussels is much higher than in London, and that English motors looked after by English engineers would probably be less expensive than those in question at Brussels, the cost of accumulator and motor renewals might reasonably be reduced in the case of the Electric Traction Company to 2d. per car-mile. This would leave the sum of 2½d. per car-mile for steam power, wages, depreciation of stationary plant, miscellaneous expenses and profit. It is possible that a large dividend could not be made out of this sum, but I can see no reason why, with careful management, accumulator traction in this country at 4½d. per car-mile should not be made to at least pay its way.

A Large Electric Power Plant.—THE ELECTRICAL WORLD of June 15 last, contained a brief note under the title of "Electrical Opportunities in Southwest Missouri," in which reference was made to possible power installations. The writer of that article had visited all the mining camps in that section; had ascertained the exact cost of small steam power to the various companies, and had furnished numerous sets of figures showing how a fair return could be realized on, say, $200,000, invested in a power plant to be located on any one of three streams, and to furnish current to countless small motors that would surely displace the portable engines employed in raising the ore. To-day the establishment of an electric power plant of at least 500 h. p. is an assured success; the stock has all been subscribed for, $300,000 paid in, and work on the plant has commenced under the general supervision of Mr. Chas. S. Rusling, the Kansas City representative of the Thomson-Houston Electric Company. Referring to the work, the Galena, Mo., paper, says: It is difficult to estimate the importance of this matter. The question of light is of little consequence when compared with that of power. If it proves a success—and those who are supposed to understand the matter thoroughly are confident it will—it will not only work a revolution in the operation of the mines, but will give our town an impetus that nothing can check. Too much credit cannot be given C. S. Rusling, C. E. Hart and the home people who were instrumental in securing to us what, in our opinion, will prove the greatest enterprise ever known in this section. There are five other points in the West to-day where an electric power plant should prove a profitable enterprise, owing to the abundant water power now going to waste. All that is required is knowledge, tact and persistency in properly presenting it to Eastern capitalists, as in the above mentioned case, for local capital is too timid. It is human nature to invest in far-off towns rather than in one's own hamlet.

PERSONALS.

Mr. Frederick Bathurst, an electrical engineer of London, Eng., has just arrived in the city. Mr. Bathurst is interested in introducing some electrical devices to American manufacturers.

Mr. L. B. Stillwell, electrician, of the Westinghouse Electric Company, read a paper on the subject "The distribution of light and power by electricity," before the Engineers' Society of Western Pennsylvania, at Pittsburgh, Pa., on the evening of March 18.

Sir David Salomons, well known from his writings on accumulators, writes to the *Electrician*, and gives some interesting points concerning the life of incandescent lamps Several hundred of his lamps have been running over 3,000 hours. He attributes this remarkably long life to the peculiarly uniform voltage on his line, the variations being less than one per cent.

Mr. William Henry Snell, editor of the London *Electrician*, died March 5 after a lingering illness. Mr. Snell was born Nov. 6, 1858. He showed in early life great taste for scientific pursuit. Before he was 20 years of age he qualified as science teacher at Kensington, and commenced teaching chemistry at Tiverton, his native town. In 1882 he brought out some inventions in connection with microphones and telephones. He then went to London and studied at the School of Electrical Engineering, where he gained high certificates. In 1883 he was appointed chief electrician to the Cunard Company, and completely reorganized their system of ship lighting. In June, 1885, he read a paper before the Society of Telegraph Engineers, entitled "Calculations of Mains for the Distribution of Electricity," for which he obtained the Paris premium. In the same year he assisted Prof. George Forbes in some important calculations in connection with the distribution of electricity over large areas.

MISCELLANEOUS NOTES.

A New Telegrapher's Journal.—The *Message*, a very readable and instructive journal devoted to the interests of telegraphers and electricians, made its first appearance recently. The paper is edited by J. F. Howell, of New York, who is a popular telegrapher, and it will doubtless receive the hearty support of the fraternity.

Protection of Buildings from Electric Wires.—Mr. Killicut, of the Boston Board of Fire Underwriters, has commenced an exhaustive series of tests of safety devices, designed to be used in low tension wires where they enter buildings, to prevent danger from fire, should they cross wires of higher tension and greater current capacity.

The Judson Pneumatic Street Railway Co., Washington, D. C., have just closed a contract with W. H. Odell, Mgr. B. W. Payne & Sons, for four 80-h. p. horizontal automatic cut-off engines for use in connection with the Judson pneumatic system of street railway car propulsion.

Consumption of Oil.—Mr. J. Meaden, the chief engineer of the Chicago Edison Company, purchased a barrel (52 gallons) of lubricating oil on January 21, and on March 7 had 18 gallons remaining. The 34 gallons consumed during these 44 days were used on five 200 h. p. high-speed engines, running at 200 revolutions per minute, during the entire 24 hours, and the 10 Edison 1,300-light dynamos belted thereto, and for pumps and general repairs, including the ash elevator, drills, etc. A total average consumption of three-fourths of a gallon of oil per day. Can this record be beaten?

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company of Syracuse, N. Y., No. 105 South Warren street.

The Ball Engine Company, Erie, Pa., have recently closed the following contracts: The Northwestern Electrical Supply and Construction Company of Seattle, Wash., have contracted with the Willamette Bridge Railway Company of Portland, Oregon, for a complete steam plant, to consist of one 150 h. p. automatic cut-off engine, two 100 h. p. boilers, with heater, etc. The Field Engineering Company of New York City have placed an order with Chas. R. Vincent & Co., agents for the Ball Engine Company, for two 150 h. p. automatic cut-off high speed engines. These engines are to be used in an electric street railway at Winston, N. C., now being constructed. The Pennsylvania Normal School at Lock Haven, Pa., have placed an order with H. M. Sciple & Co., Third and Arch streets, Philadelphia, Pa., for a 50 h. p. automatic cut-off high speed engine. The Denver Electric Illuminating Company, of Denver, Col., have recently purchased one 125 h. p. engine, making ten engines of this manufacture aggregating 1,000 h. p. The First Cincinnati Edison Electric Illuminating Company, of Cincinnati, Ohio, have recently purchased a 150 h. p. automatic cut off high speed engine. The Rittenhouse Manufacturing Company, of Passaic, N. J., have just bought a 25 h. p. automatic cut-off engine.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED MARCH 11, 1890.

422,910. System of Arc and Incandescent Electric Lighting; Harold P. Brown, of Chicago, Ill., Application filled November 25, 1885. The invention consists, in connection with an arc light or high tension circuit having one or more arc lights or other translating devices included therein in series, of a multiple arc group of incandescent lamps or other like translating devices, a variable resistance shunt or derived circuit around the group through which more or less of the current may be shunted, and an electro-magnet or solenoid, the coil of which is included in a shunt or derived circuit around the group for controlling and varying through suitable devices the resistance of the shunt.

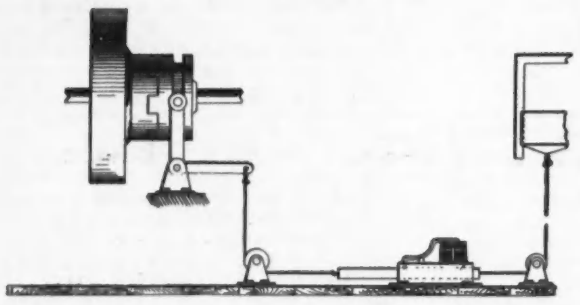
422,911. Electromotor; Henry R. Butterfield, of Waterville, Me. Application filed May 22, 1889. A commutator disc mounted upon a rotary shaft and having a protuberance from its periphery, a series of commutator springs arranged to be struck by the protuberance, a series of contact posts against which the springs are forced thereby successively, and a set of circuit wires for the magnets, the circuit being successively opened and closed as the commutator disc operates on the springs.

422,925. Zinc Electrode for Galvanic Batteries; Georges d'Infreville, of New York, N. Y. Application filed June 27, 1889. In a galvanic battery, an element of zinc or its equivalent, consisting of two or more plates or parts provided with devices for the suspension of one part from the other, the devices above and below being complementary to one another, and adapted to form a liquid tight joint or connection

422,948. System for Stopping Machines; Washington H. Kilbourn, of Olean, N. Y. Application filed Jan. 19, 1889. The combination, with a driven shaft, a battery and electro-magnet, and a bar supporting device controlled by the electro-magnet, of a bar suspended above the shaft and adapted when dropped to be moved by the shaft, and devices actuated by the bar for cutting off the driving power from the shaft.

422,956. Electric Valve Controller; Ernst R. Malmborg, of St. Louis, Mo., assignor of two-thirds to John M. Glover, of same place, and Warren B. Martindale, of Kenosha, Wis. Application filed Dec. 26, 1889. The combination, with a pivoted valve or damper and a segmental rack and pinion actuating the same, of an electro-magnet whose armature is carried upon an oscillating lever coupled mediately to the rack, whereby the movements of the armature are made to actuate the rack and operate the valve.

422,968. Electrically Controlled Elevator; Walter J. Paine, of Boston, Mass. Application filed June 5, 1889. The invention consists of a motor mechanism to cause a car or carrige



NO. 423,245.—ELECTRIC SHAFT CONTROLLER.

to travel, of a magnetic device operatively connected to the car or carriage to control the operation of the motor mechanism from the car, a manual switch and an independent automatic switch carried by the car in circuit with the magnetic device, and a cam or projection in the path of movement of the car to operate the automatic switch and stop the car.

422,975. Coupling Electric Motors; Edwin Wilbur Rice, Jr., of Lynn, Mass. Application filed Oct. 14, 1889. In a system of power distribution two or more compound-wound electric motors simultaneously in use on the same work, and each having its series field magnet coil connected with a point in the circuit to an armature of another, where the potential varies with changes in the counter electromotive force of resistance.

422,976. Reversing Trolley; Henry P. Roberts, of Rochester, N. Y. Application filed Nov. 14, 1889. The invention consists, essentially, of a trolley arm having a tendency to assume a vertical position and carrying an under contact trolley, in combination with an overhead conductor having a section or short length inclined upward and running to a height about equal to the height of the trolley arm when in its vertical position. These inclined sections of the conductor are located at both ends of the line of road and at any intermediate points where it is desirable that the vehicles should reverse their direction of travel.

422,981. Automatic Electrical Annunciator; Benjamin Franklin Shafer, of New York, N. Y. Application filed Jan. 10, 1889. The invention consists of a dial on which the numbers are registered and around which a rotating pointer is electrically impelled and automatically stopped on the number corresponding with the room or other station from which the instrument is temporarily put in electrical connection by the caller.

422,999. Field Magnet for Dynamo; Elihu Thomson and Albert L. Rohrer, of Lynn, Mass., Assignors to the Thomson Electric Company, of Conn. Application filed Nov. 25, 1889. The invention consists in making the field magnet from two or more sets of iron plates or pieces arranged circumferentially around the armature, the plates or pieces of each set being separated from one another at free air spaces, while the adjacent end of the plates of different sets are united by tie blocks or plates, at which point of connection the coils are applied.

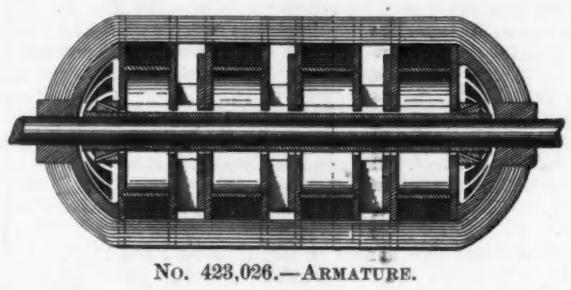
423,004. Overhead Electric System; William Vogler, of Somerville, Mass. Application filed Dec. 3, 1889. The invention consists of a re-inforcing support for the trolley wire, preferably an insulated cable of fine iron wires or strands, to which the trolley wire is secured by means of insulators interposed between the trolley wire and re-inforcing wire, the latter being supported from the span wires.

423,005. Trolley Wire Supporting Apparatus; William Vogler, of Somerville, Mass. Application filed January 8, 1890. The invention consists of a trolley wire, a series of span wires, and insulators to sustain the trolley wire and co-operating brace wires, and a supporting wire sustained thereby, the latter having auxiliary supports provided with auxiliary span wires and insulators to sustain the trolley wire at intervals between the usual span wires.

423,014. Casing for Electric or other Apparatus; Leander S. Woodbury, of Calumet, Mich. Application filed May 22, 1889. The combination, with a casing and mechanism enclosed therein, a vibratory arm extending from within outside the casing, a collar on the arm near its centre of vibration, an inwardly projecting flange surrounding the opening through which the arm passes, and a flexible tube surrounding the arm and fitted at its ends to the collar and flange.

423,023. Underground Electric Conduit; Augustus Bruner, of Indianapolis, Ind. Application filed Nov. 11, 1889. The process of constructing conduits, which consists of placing a layer of concrete in a trench, and setting one or more series on independent cores therein above each other, held in position at one end by a head board, the other end of the cores being supported by the openings of the last sections made, and filling in about the cores with a mass of homogeneous cement or similar material, allowing such mass to settle, and then withdrawing the cores.

423,026. Armature; Robert L. Cohen, of Camden, N. J. Application filed June 19, 1889. The invention consists in the combination, with a solid shaft and a brass or other non-magnetic sleeve provided with longitudinal ribs, of a series of spools, above mentioned, the end plate of the spools being cut away next to the sleeve, so as to leave a free space throughout the length of the



NO. 423,026.—ARMATURE.

sleeve for the passage of air. The air enters the ends of the armature and communicates with the interior of the spools and the spaces between the same.

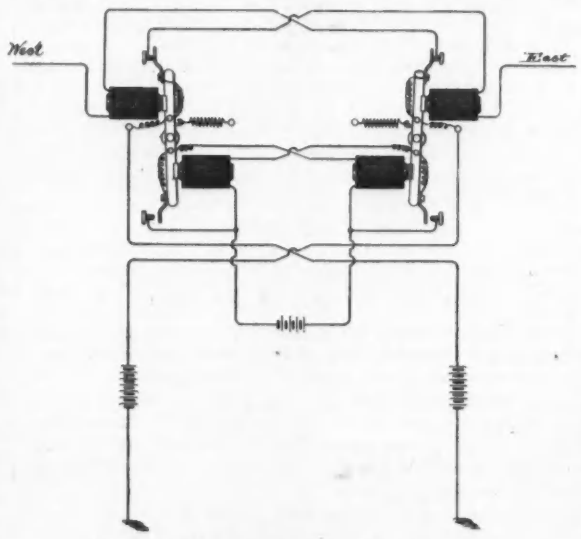
423,029. Regulation of Alternate-Current Generators; Stanley C. C. Currie, of Philadelphia, Pa., Assignor to the United Electric Improvement Company, of Gloucester City, N. J. Application filed Dec. 5, 1889. The combination of an alternating generator and its exciter, a distribution circuit, leading from the alternating generator, and a storage battery connected in circuit with the exciter and circuit connections whereby when the lamp load is light the exciter is run as a dynamo to charge the storage battery and when the load is heavy the discharge from the storage battery drives or assists in driving the shaft of the generator.

423,091. Method of Preparing Active Material for Secondary Batteries; Charles Sorley, of New York, N. Y., assignor to the Anglo-American Electric Light Munufacturing Company, of West Virginia. Application filed Nov. 12, 1889. The invention consists in preparing active material for use in a secondary battery electrode by subjecting an active material to the action of a fluid capable of expanding the material, and then drying the material prior to combining the same with the electrode.

423,101. Process of Electroplating Non-Metallic Articles; William H. Winslow, of Chicago, Ill. Application filed Oct. 28, 1889. The invention consists in applying, to or over the surface of the article to be coated with metal, metallic strands or fine wires, which are connected with the electric conductors through which the current passes and which serve to produce a practically simultaneous and uniform deposit of metal on the surface of the article.

423,102. Thermal Cut-Out; James J. Wood, of Brooklyn, N. Y. Application filed Oct. 21, 1884. A cut-out consisting of terminal contact seats connected with the circuit wires, a separable destructible bridge extending across between the seats with its ends overlying them, and a cap or cover constructed when applied exert an unyielding pressure against both ends to press them into firm electrical contact with the seats.

423,134. Laying Electric Conductors; Thomas Jefferson Cope, of Philadelphia, Pa. Application filed July 26, 1889. An air tight plug having a removable reel therein adapted to be used



NO. 423,229.—TELEGRAPH REPEATER.

with a carrier or projectile, and means, connected with the plug for moving projectile.

423,207. Portable Electric Lamp; Alexander H. Bauer, of Chicago, Ill., Assignor to the Pullman Palace Car Company, of same place. Application filed August 10, 1889. The invention consists of a portable incandescent electric lamp, having a bracket arm secured therewith, of a socket or receptacle adapted to receive the end of the bracket arm and having spring clamps therein, binding posts, and a block having metallic bushings to receive the posts, the bushings forming the terminals of an electric circuit.

423,210. Electric Meter for Alternating Currents; Otto Titus Blathy, of Buda-Pesth, Austria-Hungary. Application filed October 7, 1889. The invention consists of a metallic rotating body, which is acted upon by two magnetic fields or two groups of fields displaced in phase from one another. The displacement of said phases results from the fact that a field or one group of fields is produced by the main current, while the other field or group of fields is excited by a coil of great self-induction shunted from those points of the circuit between which the energy consumed is to be measured. The magnetic fields, however, do not cross one another within the solid of revolution.

423,223. Electric Heating Apparatus; Mark W. Dewey, of Syracuse, N. Y. Assignor to the Dewey Corporation, of same place. Application filed December 13, 1880. The invention consists in the combination, with suitable supply conductors, of a resistance or radiating device composed of thin, flat sheets of metal, preferably of iron, connected together in series, the sheets arranged parallel side by side, and with air-spaces between them,

423,229. Telegraph Repeater; Sidnesy S. Emery, of Newton Center, Mass. Application filed April 27, 1889. The combination, in a telegraph repeater, of the main lines, the relays and the local magnets for keeping the sending line closed, with centrally pivoted relay armatures and spring contacts, carried on opposite ends of the armatures, one contact controlling the main receiving line and the other contact controlling the circuit of the local magnet for keeping the sending line closed.

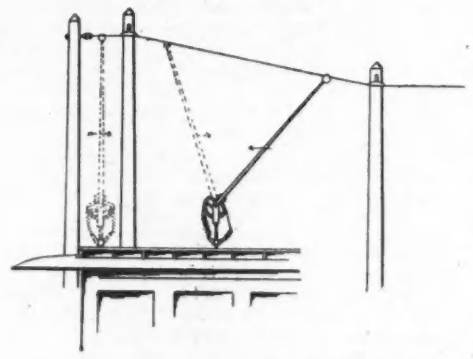
423,245. Electric Sha't Controller; Anthony W. Hart, of Boston, Mass. Application filed June 29, 1889. The combination, with a bracket, provided with belt shifting fork and sliding bar, of guides or ways, one of them provided with an opening, a detent passing through the opening and adapted to engage with a notch in the sliding bar, an electro-magnet adapted to withdraw the detent, and a weight for moving the bracket.

423,286. Stationary Fire-Extinguishing Apparatus; William C. Smith, of New Haven, Conn., Assignor of one-half to Charles E. Rounds of same place. Application filed Feb. 8, 1889. The combination, with a stationary fire-extinguishing apparatus, having one or more thermostatic sprinkler heads, of a signal transmitter adapted to be operated automatically, a signal receiver, elective connections between the transmitter and receiver, a valve or movable part located in a pipe of the apparatus and operated by the flow of water therein, a pin directly connected to the valve or movable part, and a connection with the transmitter normally locked by the pin, whereby the pin normally prevents the automatic operation of the transmitter, but releases the latter for such operation when the valve or movable part is moved by the flow of water in the pipe.

423,299. Ear-Phone for Telephones; Julius J. Wolf, of Kansas City, Mo., Assignor of two-thirds to Max Weil and Aaron M. Sloss, both of same place. Application filed Jan. 24, 1890. An ear phone having a body and an interior drum covered by a cloth and provided with a perforation, the interior drum being provided with a groove or channel, which fits over the flange end of the phone, and the body provided with an accordian plaiting secured around a spiral spring to regulate the distance between phone and ear.

423,309. Holder for Commutator Brushes; Jacob C. Chamberlain, of New York, N. Y. Application filed May 29, 1889. The combination of a holder proper, graphite collector or tablet, loosely held and guided therein, the spring-depressed arm and its attached rocker, the supplementary springs or sound-deadeners, and the plate conductor, interposed between the sound deadeners and such tablet.

423,310. Connecting Device for Battery Terminals; Rufus N. Chamberlain and Jacob B. Chamberlain, of New York, N. Y.



NO. 422,976.—REVERSING TROLLEY.

Application filed Nov. 12, 1889. In combination with the flat terminal bars of a battery, a clamping or connecting device consisting of a band or screw of hard rubber, a resilient cushion within the band at one end, and a washer or follower to receive the pressure of the screw at the other end.

423,324. Secondary Battery; William A. Johnson and Jas. Norman Smith, of Toronto, Ontario, Canada. Application filed June 27, 1889. An electrode for a secondary battery or accumulator, composed of one or more plates of lead or other suitable material, each plate having a longitudinal groove or grooves made in its surface to receive and retain the active material of the electrode, the walls of each of the grooves being burred or notched.

433,335. Dry Galvanic Battery; Louis Moorthamers, of Brussels, Bel. Application filed May 21, 1889. Patented in Belgium, Aug. 11, 1888; in France, Dec. 6, 1888; and in Germany, Dec. 8, 1888. An electric dry battery having an exciting paste composed of ammonium chloride, chalk, and hydrochlorate of lime.

143,361. Coin Operated Electric Apparatus; John Stewart Wallace, of Belfast, Ireland. Application filed Aug. 29, 1889. In an apparatus for permitting the self-administration of electric currents upon the insertion of a coin therein, the combination, with a movable handle and an induction coil provided with means, for varying the strength of the current, of a series or chime of bells provided with hammers or clappers, and levers intermediate the hammers, and the movable handle whereby when the handle is operated the bells will be successively sounded to indicate the increase in the strength of the current.

423,385. Alarm for Gas-Pipes; Americus Miesse, of Lima, Ohio, Assignor by direct and mesne assignments, of one-half to John Hubbard, of same place. Application filed May 25, 1888. The invention consists of a gas chamber formed of two cups provided with flanges for the purpose of joining them together, an insulated contact screw in each cup, a diaphragm located in the chamber and between the two screws and adapted to come in contact with one when the pressure is too high or too low, and electrical connections arranged to give an alarm under such conditions.

423,391. Trolley for Overhead Electric Railways; Frank B. Rae, of Detroit, Mich. Application filed Nov. 14, 1889. In a contact arm for electric railways, the combination, with a suitable support, of a socket piece for the arm provided with a disc having slots therein, and springs secured to the base on opposite sides of the disc and engaging the slots.

423,400. Electric Motor Car; Detlef C. Voss, of Medford, Assignor of one-half to Edward A. Clark, of Boston, Mass. Application filed Dec. 4, 1889. The combination, with an electric motor, car and railway therefor, both in the same electric circuit, of appliances, which are held on and are distinct and separate from the wheels of the car, and are adapted to be placed in and out of contact with and in contact to travel along the railway, and of an electrically operated device in circuit between the contact appliances and the motor of the car, to close and to open the electric circuit of the appliances.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give date and number, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.